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VOLUME 10, NUMBER 10 • DECEMBER, 1954

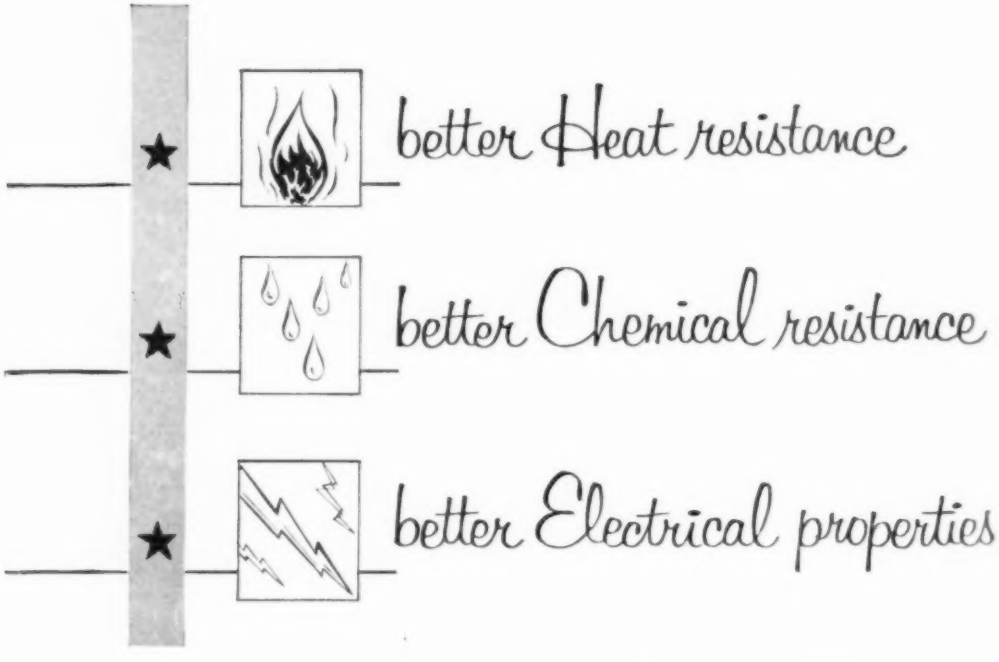
John
LaCerda
(See page 46)

John LaCerda, famous public relations expert, will be luncheon speaker at the Eleventh SPE Technical Conference, Atlantic City, January 19-21.

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

Important news!

EPON® resin 828 with new Curing Agent CL gives



If you are among the many users of Epon resin 828 for casting, laminating or other structural applications—you will welcome this new development of Shell Chemical's continuing research program.

Curing Agent CL* produces Epon resin polymers with improved mechanical and electrical properties at temperatures as high as 300° F. After three hours' immersion in boiling water or acetone, glass cloth laminates of Epon resin 828 and Curing Agent CL retained more than 95% of their initial dry flexural strength. And with Curing Agent CL you can use the "B-stage," or pre-curing, process—permitting dry layups and specialized casting techniques.

Your request will bring you a sample of Epon resin 828 and Curing Agent CL for evaluation, as well as a copy of Technical Bulletin SC:54-10. Write for them—today.

Curing Agent CL is Shell Chemical Corporation's name for metaphenylene diamine. We do not manufacture Curing Agent CL. It is available in commercial quantities from E. I. du Pont de Nemours & Company and National Aniline Division, Allied Chemical & Dye Corp.

*A development of Shell Chemical laboratories. Patent applied for.

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SPE JOURNAL

VOL. 10 December, 1954 No. 10

Published monthly except July and August by

THE SOCIETY OF PLASTICS ENGINEERS, INC.

30 cents a copy $3.00 per year

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JESSE H. DAY, Editor

Editorial Offices

SECURITY BANK BUILDING
ATHENS, OHIO

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34 EAST PUTNAM AVE.
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• *All copy intended for publication in the SPE Journal should be directed to the Editorial Offices. Copy for each issue should be received at Athens, Ohio, before the first of the preceding month. Neither The Society of Plastics Engineers nor the SPE Journal is responsible for the views expressed by individual contributors.*

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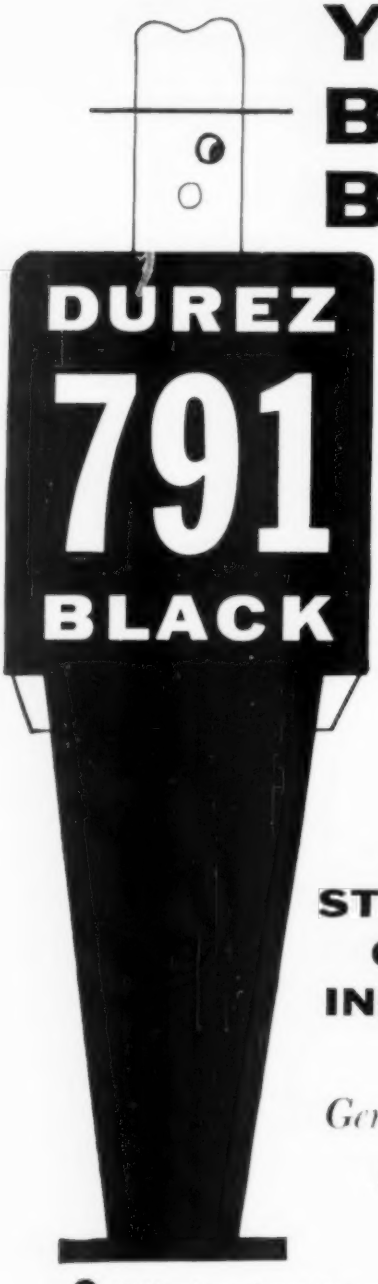

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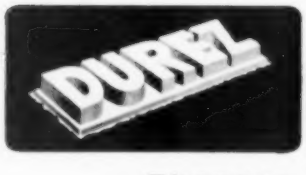

PHENOLIC RESINS
- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- PROTECTIVE COATING RESINS

Phenolic Plastics for the New Era of Competition

Book Reviews . . . .

TOXICITY OF INDUSTRIAL ORGANIC SOLVENTS E. Browning; Chemical Publishing Company, Inc., New York, 1953. $8.00

This book is the reprinted revised American edition of a report of the Toxicity Committee of the British Medical Research Council. It gives substantial information on the toxicity of the various organic solvents considered as a hazard in industrial plants. However, the author limits herself to the industrial aspects of toxicity and this prevents her from describing all the phases of toxicology which do not occur in plants, despite the fact that these valuable data add very much to the knowledge of the individual harmfulness of a chemical. For instance, the toxicity by oral ingestion of these solvents in man has been voluntarily omitted because such poisoning is practically non-existent in plants. On the other hand, the oral toxicity on animals is fully treated.

The first two chapters describe the hydrocarbons, the following three chapters deal with the alcohols, ethers and esters. Then the ketones, glycols, amines, and nitrated compounds. The last chapter, devoted to miscellaneous compounds, contains a few pages on the toxicity of silicones and silane intermediates.

This book will be useful to manufacturers, industrial physicians, toxicologists and labor organizations.

Dr. Louis C. Bar...

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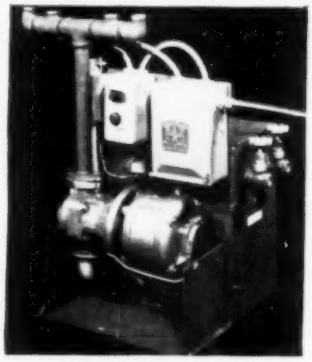

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The IMS Low Cost Circulator Performs The Same Job As Big Costly Units At Less Than Half The Price!

Across the Editor's Desk . . . .

• Note from Australia: Melbourne Technical College now offers a diploma course in Plastics Technology. The required courses are:

FIRST YEAR	
Organic Chemistry	1 hour per week
Mathematics	2
Physics	2
SECOND YEAR	
Plastics Technology	2½
Mathematics	2
Engineering Drawing	4
THIRD YEAR	
Plastics Technology II	2
Workshop Technology	2
English	2
FOURTH YEAR	
Plastics Engineering	2
Industrial Design	2
English	2
FIFTH YEAR	
Plastics Engineering II	2
Management Principles	2
Applied Electricity	2

• From Japan comes a 10 page mimeographed bulletin "The Development of Plastics Industry in Japan" by R. Iwaide of Tomio-cho, Nara-ken, Japan. Contents (in English) give a breakdown of plastics made, and products and producers. Price is 100 yen.

• Plastics have been used as fibers in the textile industry for a good many years, and now comes news about the man nipping at the dog—textiles are becoming plastics, in a way of speaking. A major step in this direction, aimed at improving the competitive position of cotton, is the opening of a pilot plant for treating cotton with acrylonitrile at the Institute of Textile Technology, Roseville, Ga. Twenty thousand pounds of cyanoethylated cotton is to be produced in nine months to be service-tested.

• **Western Plastics** is the title of a new plastics magazine whose first issue is October 1954. Their purpose is to provide a monthly digest of plastics activities in the 11 western states and Texas. Editor is Frederick Rea, publisher Western Business Publications, 274 Brannan St., San Francisco. Their first issue is 44 pages, very interesting and well set up. Western Plastics is another sign of the growth and importance of the West in plastics.

• The Annual Handbook of Product Design published by McGraw-Hill, 330 W. 42nd, New York, has just reached our desk. The Handbook comes as part of a subscription to Product Engineering at five dollars a year. Might as well mention that it reprints an article from the SPE Journal. A big book, it weighs over 4 pounds!

• When your editor was considerably younger he invented a three-dimensional chess game, but abandoned it when the first game took over two months to finish. More realistic is a three-dimensional tic-tac-toe game called Qubic, put out by American Homecraft of 3714 N. Milwaukee, Chicago, which is both feasible and fun. It is, we are happy to say, constructed entirely of polystyrene.

meet 'S-T-R-E-T-C-H'

Another Gering blessed event

POLYETHYLENE COLOR CONCENTRATE

save **5¢** *to* **15¢** *per product pound*

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KENILWORTH, N. J.

Design Contest for Styrene Molders Announced by Koppers

A Design Competition for Plastic Molders, the first of its kind in the plastics industry, has been announced by Koppers Company, Inc., which will sponsor this unique, nation-wide event. The competition is designed to lend active, tangible support to the concepts outlined in the "Statement of Principles of the Plastics Industry" promulgated by the Manufacturing Chemists Association, Inc.

Aimed generally at encouraging the upgrading of all plastic products, the Statement of Principles advocates the promotion of correct design and proper application of plastics in consumer products.

To this end, the Koppers Design Competition is set up to award substantial recognition to polystyrene molders whose housewares products excel in design, quality, and imagination.

An impartial panel of authorities in the design, engineering, and marketing fields will act as judges. This panel of noted experts will consist of: Raymond Loewy Associates, Industrial Design Consultants; Dr. Jesse H. Day, Editor, Society of Plastics Engineers JOURNAL, and Member, Society of Plastic Engineers; and Dr. Hugh G. Wales, Professor of Marketing, University of Illinois, and Secretary of the American Marketing Association.

Three scholarships lead an impressive list of benefits to be awarded by Koppers to first-prize winners in three competitive product classes. This top award will be a grant of a one-year, full tuition scholarship, for studies related to product design, at a qualified college or university chosen by each of the winning molders. Each scholarship will bear the name of the winning molder, and will be awarded to a qualified student selected by the college or university.

Products entered in the contest may be molded or extruded of any regular or modified polystyrene, and must be designed and produced by the molder for sale as a housewares item. All molders of polystyrene housewares, regardless of whose material they use, are eligible to enter the competition.

Entries will be considered, and awards made, in three categories. They are: Class I—Utilitarian products with operative construction features; Class II—Utilitarian products with non-operative construction features; and Class III — Decorative products with or without operative construction features.

Examples of the types of products applicable to these three groups would be: Class I — a vegetable shredder; Class II — a cereal bowl; and Class III — a wall planter. A production sample of each entry to be judged must be received by Koppers no later than January 10, 1955.

Koppers Design Competition is timed to climax the housewares industry's traditional "new product month" of January, and most of the entries will be prominently displayed at the big housewares show in Chicago (Ill.) January 13-20, 1955.

Winning products will be displayed and merchandised as part of a nation-wide promotion directed to the buyers of housewares.

In addition to the scholarships and other awards, the three winners will receive attractively engraved plaques. Two Honorable Mention awards, also, will be made in each of the three classes.

Winners will be announced and awards presented at an Industry Banquet to be sponsored by Koppers on March 21, 1955, in Pittsburgh, Pa.

Mr. Vacuum Bag Molder:

NOBODY BUT NOBODY

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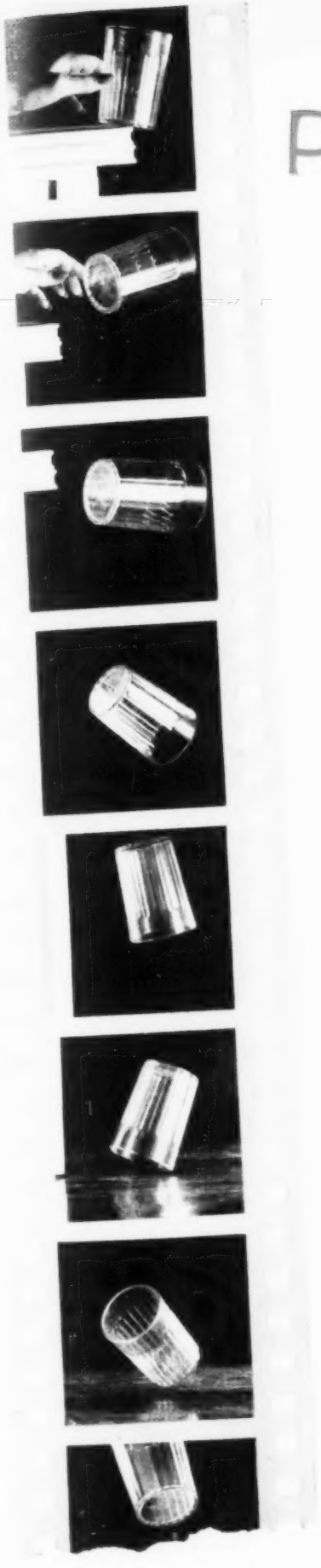

Pushed off a table 100 times— still looks new!

Tumbler made of BAKELITE C-11 Plastic takes 100 falls 3 feet onto a tile floor with no visible effect!

You can imagine what this test would do to an ordinary tumbler. The tumbler above not only refused to break, it showed no signs whatever of chipping or crazing. In restaurant and institutional use, these tumblers made of BAKELITE C-11 Plastic are helping cut breakage costs by as much as 8 to 1!

BAKELITE C-11 Plastic, an acrylonitrile-styrene copolymer, was developed especially for injection molding and extrusion. It has good flow characteristics and fast set-up. You can mold it in large areas and thick or thin sections without voids, bubbles or sink marks. You can machine it easily. Clarity is excellent, color range very broad.

Laboratory and use tests show exceptional resistance to soaps, food chemicals, oils, solvents and acids, making BAKELITE C-11 Plastics useful for industrial, household and food handling applications. They also suggest a host of automotive, electrical and aeronautical uses.

You'll want to learn more about this tough, practical, easily fabricated material. Write to Dept. AE-43.

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C-11 PLASTICS

TRADE MARK

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.
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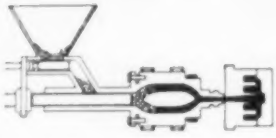

temperature control for injection molds

before you buy... look at SARCOTROL

Yes, compare the completely redesigned SARCOTROL mold heating and cooling unit with all competitive types. It maintains even face temperatures by recirculating temperature-controlled *water* through molds at high velocity. Write to Sarco Company, Inc., Empire State Building, New York 1, N. Y.

Check these Sarcotrol features!

- Independent circulating systems.
- No need for special heat transfer liquids for temperatures to 250°F.
- Automatic heater protection.
- Automatic heating rate selection.
- Saves electricity and water.
- One knob changes temperature control setting.
- Many other features.

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News of the Industry . . .

Plastics Fair for Los Angeles

The World Plastics Fair and Exposition is set for April 6-10 in Los Angeles. Designed as a trade and consumer show, it will be open to both the trade and the public, but is restricted to the trade the first three days. The trade presentation will be similar to that of the 1954 Plastics Exposition in Cleveland. Exhibitors will be from every category, and will include foreign machines and products. A trade attendance of 18,000 is expected, at the National Guard Armory in Exposition Park. In charge is Philip Kent, 8762 Holloway Drive, Los Angeles 44, California.

Toxic Hazards Info. Available

Serious problems both from known and potential toxic hazards in chemicals used in the plastic industry are facing industrial medicine and hygiene, according to an article by Rex H. Wilson, M.D., and William E. McCormick, of The B. F. Goodrich Company, Akron, Ohio, in the November issue of **Industrial Medicine and Surgery**, the official publication of the Industrial Medical Association.

The authors in this article have accumulated for the first time a comprehensive summary on the toxicology of plastics, a task that no one has attempted previously.

Stressing that much additional toxicological study is necessary on plastics, the authors warn that "if the sales potential of a new plastic does not warrant toxicological study, then the product should not be produced."

To obtain the complete article, please write to: Mr. A. D. Cloud, Publisher, Dept. SPE, Industrial Medicine and Surgery, 605 North Michigan Avenue, Chicago 11, Illinois.

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the LATEST ADVANCES in Mold Base Design Standards

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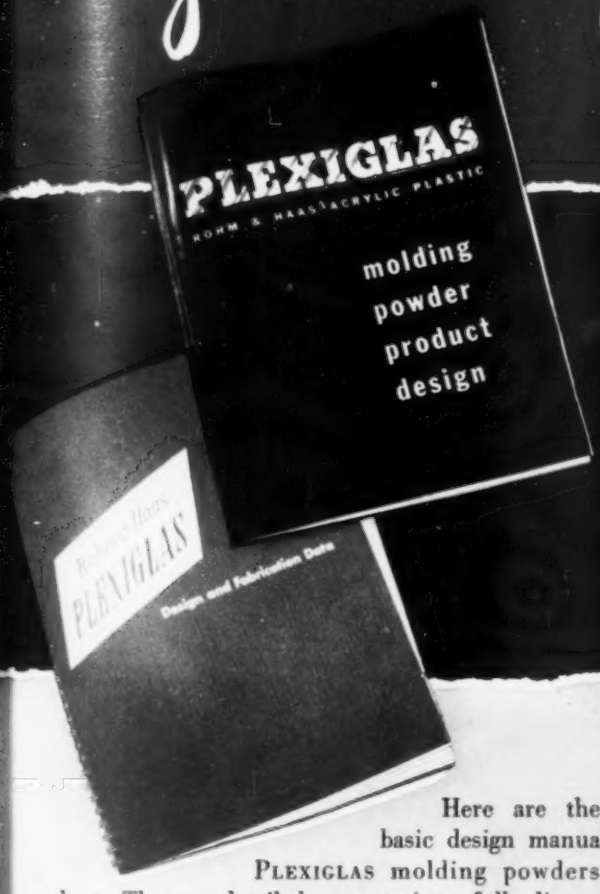
guides to good design in Plexiglas



Here are the two basic design manuals on PLEXIGLAS molding powders and sheets. They are detailed presentations, fully diagrammed and illustrated, showing the best ways to make use of this Rohm & Haas Company acrylic plastic.

Molding Powder Product Design discusses principles of optical design, decorative effects, and methods of attaching molded PLEXIGLAS parts.

Design and Fabrication Data covers the fabricating techniques and design considerations for making products from PLEXIGLAS sheets.

Strength, beauty, dimensional stability, resistance to weather and breakage—these are some of the properties that make PLEXIGLAS a preferred material for scores of industrial and commercial products. The brochures shown above have been prepared to help product designers and engineers use these properties to best advantage. To obtain your copies promptly, just use the coupon below. In addition, we will be glad to advise you on how a specific design problem may be solved with PLEXIGLAS.

ROHM & HAAS COMPANY

Dept. SF, Washington Square, Philadelphia 5, Pa.

Please send me:

☐ "Molding Powder Product Design".

☐ "Design and Fabrication Data".

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PLEXIGLAS *is a trade-mark, Reg. U.S. Pat. Off. and in other principal countries in the Western Hemisphere.*

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Representatives in principal foreign countries

"LUSTREX HI-FLOW 55 – the greatest improvement in styrene in years!"

Mr. Henry Frey, Plant Supt.
Banner Plastics Company
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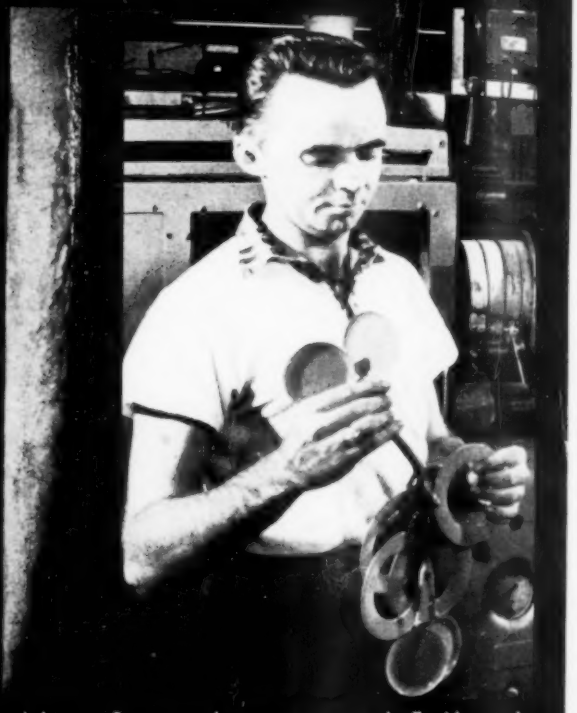
Toy dishes, molded of Lustrex Hi-Flow 55 are ready for easy removal from Banner Plastics Company's injection machine. Rejects and breakage are cut to a minimum!



Runners and gates are snapped off with ease because Lustrex Hi-Flow 55 is less brittle and stronger than ordinary styrene.

Speed cycles—cut costs—boost profits with HI-FLOW 55 MONSANTO LUSTREX® Styrene Plastic

"Monsanto's Lustrex Hi-Flow 55 is one of the finest improvements in styrene I've seen," says Mr. Frey. "Because it is far less brittle than ordinary styrenes, releases more easily from the mold and requires fewer stops for lubrication, Lustrex Hi-Flow 55 styrene has saved *2 to 3 seconds on our cycle time!* And we're getting *5% more production* per man, per machine!"

These results are typical of what happens when Lustrex Hi-Flow 55 styrene enters the molding picture. Lustrex Hi-Flow 55 molds at *25° to 50° lower* than general-purpose styrenes—eliminates surface flaws and weld marks; makes strain-free parts. Rejects are cut to a minimum. This soft-flowing styrene molding powder can be used in any standard injection, compression or extrusion machine.

Put Lustrex Hi-Flow 55's work-saving, cost-cutting advantages to work for you today. It's perfect for packaging and food containers, pin-point gating, deep draws, and uniform thick or thin wall sections where general-purpose styrene has trouble in filling.

For full information, write MONSANTO CHEMICAL COMPANY, Room 2910, Springfield 2, Mass.

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YOUR NATIONAL OFFICE

To The Members:

One of the minor services of the National Organization to its members is that a member, wishing to do so, can place a classified "position wanted" advertisement in the SPE JOURNAL **free of charge.** Write me for further information!

In The Service

Regarding another little-publicized policy of the Society concerning membership, the following letter will be of interest:

Dear Mr. Underwood:

Thank you for your letter and my membership card for 1954-55. I think that the Society's policy of waiving membership dues for members on active duty in the Armed Forces is excellent, since it is so easy to let a membership lapse by default of dues payment with the separation from active membership and the financial burden of military service, in addition to the normal moving around necessitated by service—and such default can be completely unintentional. And, in addition, it helps keep you in touch with the industry, its trends and changes through the SPE Journal. My thanks and congratulations to those who had the foresight to sponsor this idea.

Very truly yours
Thomas M. McGuire

The Membership Campaign

The membership campaign is still underway and shooting for a total membership of 5,000 by June 30, 1955 (see page 50.)

The Section Membership Competition Chart has been discontinued; instead, in each issue of the JOURNAL the names of new applicants will be listed by sections. Perhaps you will want to get acquainted with the applicants in you arrea at your next section meeting.

Sincerely,

P. L. Underwood

Executive Secretary

HELP WANTED

Your Society has shown a rapid growth in members due in a large part to the fruitful activities of the Membership Committees. This increase in number of members means that we represent a large segment of the plastics industry. We have a definite obligation to render to this industry—the services which a Society such as ours is expected to render. Up until this time, we have failed in part of this task, chiefly because we have attempted to initiate a program so wide in scope that it died of its own weight.

Our Society has the manpower and these men have outstanding ability in their particular branches of the industry. In fact, many of our good members render a service to the industry as individuals and your Society is not mentioned. Recently, your National Council undertook a positive action through the function of the Professional Activities Committee. We assigned to this Committee the revision of the textbook on "Injection Molding" written by Islyn Thomas. We need other assignments such as this. Some of these problems might be small problems, or they might be problems involving years of continuing studies such as specifications, testing methods, evaluation of new materials, and the like.

Each of you as individual members of the Society has a right to submit a problem so that you may derive more benefit from your membership. Rest assured that every problem will be given full consideration and those to which S.P.E. can contribute most effectively will be selected for action. The old adage that you get out of a thing only what you put into it might seem to be a hackneyed expression but those of you who have been active in Society work and have done a creditable job on the tasks assigned to you, can look back with pride on a job well done. To be true, these jobs entailed a great deal of hard work. In fact, at times it was even disagreeable work, but after completion you realized that you had increased your knowledge and has made a contribution to the industry which provides your livelihood.

Let us demonstrate that our increase in number has increased our willingness and desire to strengthen the S.P.E. By rendering services for its members and the Industry in general, your Society demonstrates its reason for being.

Make no mistake—we are looking for ways in which the SPE can serve the plastics industry and the men in the plastics industry. We are looking for specific problems—and we mean business! **Your** ideas are needed. Write to John LaBelle, President SPE, 34 East Putnam Ave., Greenwich, Connecticut. SPE is **your** Society. Work for it and put it to work.

John LaBelle
National President

Ladies attending the conference will have the opportunity to see the display of fine china in the modern, new display rooms of the Lenox China Co. at Pomona, New Jersey. Transportation will be furnished on Thursday and Friday mornings for those who wish to go. Many unusual patterns will be on display in a museum-type exhibit.

Especially For The Ladies . . .

Tours, Fashion Shows, Teas

LENOX TOURS:

Thursday and Friday A.M.

A very new Lenox china factory and show room has been opened at Pomona, New Jersey, just a few miles outside of Atlantic City. There will be several buses leaving the Haddon Hall on Thursday and Friday mornings to go to the Lenox show room. Many women consider Lenox the finest china in America.

One section of the showroom is devoted to a museum-type of exhibit which displays extraordinary patterns—Presidential China, etc. Aside from very ornate patterns, there are many modern-type dishes from which to choose. Also, dishes may be purchased right there, or gift-wrapped if one wishes.

HAT SHOW:

"Grandma Buys a Hat" should be an enticing invitation to see a collection of this year's newest hats for *Young* or *Old!*

On Wednesday afternoon at 2:30, Catherine Jackson Millinery will present this show in the Carolina Room. Grandma knows what she wants in a hat for herself, but her modern-minded daughter has other ideas. After looking dubiously at many designs the granddaughter of the family comes to grandma's rescue and everyone leaves the shop happy. A musical background accompanies this whimsical little story. Please note that the luckiest lady present will go home with a $25.00 hat.

FASHION SHOW:

The Moore Institute of Art, Science and Industry is a well-established school founded in 1844. (It was formerly the Philadelphia School of Design for Women.) Many varied courses are offered there: Art Education, Illustration, Textile Design, Fine Arts. One of its most exciting features is the Department of Fashion Design, the head of which is Mr. I. Albert Gordon. The Fashion Show will include Mr. Gordon's students who design and make the clothes as well as model them. Talent is abundant as is demonstrated at these shows, with ensembles ranging from casual and at-home numbers to the newest creations for the cocktail hour and formal occasions. Where is the woman who doesn't enjoy beautiful clothes? There will be 15 models and approximately 80 gowns in this show!

Complete Ladies' Program

Wednesday, January 19

10:00 A.M. to 12:00 "Get Acquainted Coffee Hour"—Registration Room—Sunporch

12:30 P.M. to 3:00 P.M. Ladies Luncheon—Mal Dodson, Atlantic City Publicity Director to welcome guests—Carolina Room—Chalfonte

3:00 P.M. to ? Free to shop, visit famous restaurants, etc.

Thursday, January 20

9:30 A.M. "Coffee Get Together"—Registration Room

9:30 to 11:30 Tour of Lenox China Factory, Pomona, N. J. (Group A)

or

Tour of Hotel Kitchens and Bakery (Group B)

1:00 P.M. to 4:00 Ladies Luncheon—Fashion Show given by Moore Institute of Art; 15 models—80 Gowns Carolina Room

6:00 P.M. President's Reception and Cocktail Hour (with men).

7:00 P.M. Banquet, Entertainment, and Address by Gen. Bondley.

10:00 P.M. Cabaret, Dancing.

Friday, January 21

9:30 A.M. "Coffee Get Together"—Registration Room

9:30 to 11:30 A.M. Tour of Lenox China Factory, Pomona, N. J. (Group B)

or

Tour of Hotel Kitchens and Bakery (Group A)

2:00 P.M. to 3:30 Afternoon Tea—Musical Show by Popular Star Bob O'Neill—Music Room—Chalfonte

Mary C. Koch

John A. Jackson, Jr.

JACKSON, KOCH PLAN LADIES PROGRAM

Arrangements for the ladies' program shown on these pages were made by John A. Jackson, Jr., and Mrs. Mary C. Koch. You will find that enough events are scheduled to keep the participants busy, but that ample time has been provided for relaxation and enjoyment of the many offerings of famous Atlantic City.

MUSICAL TEA:

On Friday afternoon, a musical tea is planned as the grand finale. Our guest will be the ever-popular star, Bob O'Neill, who can play any request from Bach to Boogie-Woogie. He is just as versatile in his vocalizing as in his piano interpretations. This "Liberace of Atlantic City" will be heard to best advantage in the lovely Music Room at the Chalfonte.

OPTIONAL:

Guided tours around the Island of Atlantic City, visits to hotel kitchens and bakeries to watch renowned Frech chefs at work.

The ladies Entertainment Committee is doing everything possible to make your stay enjoyable and exciting. However, if you don't like this fast life, you can relax on the sun porch, walk the boards or ride the old-fashioned wicker chairs or the more modern electric cars.

We'll be looking for you on the Boardwalk!

The scene below will be repeated for ladies who attend the conference by the Moore Institute of Art, Science and Industry. Mr. I. Albert Gordon, head of the school's Department of Fashion Design, will have his students model the fashions they have created.

Papers, Panels Listed For:

11TH ANNUAL TECHNICAL CONFERENCE

From the great wealth of material available for presentation at the January conference, the committee has selected and scheduled sixty papers, some of which have been grouped into eight symposia or panels. This means that for the first time at a SPE conference there will be **three simultaneous sessions.**

The complete schedule, showing the exact time at which each panel or discussion will be held, will be mailed to each member immediately after Christmas. However, for the convenience of the members in deciding how many associates to bring with them to the conference, we are listing below all those which are definite, at this time, amounting to approximately 80% of the schedule.

PANEL NUMBER 1 . . . FLUOROCARBONS

George Koch—Moderator

Jules Jupa
M. W. Kellogg Co.
Properties and Characteristics of "KEL-F"

Wm. Campbell
U. S. Gasket Co.
Molding and Fabrication of Polymonochlorotrifluoroethylene

C. M. Hobson
U. S. Gasket Co.
Molding of Teflon

L. S. Bovier
Hooker Electrochemical Co.
Fluorolubes, Lower Molecular Weight Polymers of Chlorotrifluoroethylene

R. C. Doban

B. W. Sandt

C. Speratt
E. I. du Pont Company
Physical Properties of "Teflon" Resin

★ ★ ★

PANEL NUMBER 2 . . . POLYETHYLENE

Ed Childs—Moderator
Monsanto
Polyethylene's Future

J. E. Brister
Bakelite Corporation
Progress in Materials and Fabricating Techniques

Chas. Harper
Sears, Roebuck and Company
What Makes The Sale?

★ ★ ★

PANEL NUMBER 3 . . . CONTROLS

Paul A. West—Moderator
Sterling, Inc.
General Principles of Mold Temperature Control

C. H. Whitlock
C. H. Whitlock Assoc.
Temperature Control With Mold Design

Gordon Thayer
Dow Chemical Co.
Mold Temperature Control From Material Supplier Point of View

H. E. Shugars
Wheelco Instruments Div. of Barber-Colman Co.
No Title As Yet

Everett R. Brown
Automatic Temperature Control Co.
New Techniques in Controls for Injection Molding: "Time Weigh and Count By Precision Methods"

PANEL NUMBER 4 . . . REINFORCED PLASTICS

I. M. Scott—Moderator

H. L. Darby

Edward Culwick

Arthur Douglas

Thomas Scheirer
Winner Manufacturing Company
Properties, Uses and Design Considerations in Glass Reinforced Plastics

James W. Case
Navy Bureau of Ordnance
Research Work Being Done On Reinforced Plastics Under Bureau of Ordnance Contracts

★ ★ ★

PANEL NUMBER 5 . . . TOOLING FOR REINFORCED PLASTICS

H. S. Nathan—Moderator
Atlas Plastics

S. Fingerhut

P. Levy

J. Marzicola
Zenith Plastic Co.

O. Silverwood

G. Stamos
Factors Affecting Production Tooling for Reinforced Plastic Components

★ ★ ★

PANEL NUMBER 6 . . . HEATING CYLINDERS

E. W. Cronin—Moderator
Hercules Powder Co.

C. E. Beyer

R. B. Dahl
Dow Chemical Company

R. B. McKee
Injection Molding Machine Heating Cylinder Design

★ ★ ★

PANEL NUMBER 7 . . . MOLD CONSTRUCTION

Islyn Thomas—Moderator
Thomas Engineering Co.
Material for Mold Construction

S. G. Fletcher
Latrobe Steel Co.

G. Brumbach
Carpenter Steel Co.

H. Becker
Crucible Steel Co.

L. J. Morrison
Detroit Mold Engineering Co.

SPEAKERS AND TITLES OF PAPERS

A. M. Medora
Anderson Button Works, Inc.
Compounding Polyvinyl Chloride Using the Powder Mix Technique

G. S. Irby
General Electric Co.
New Silicone Rubbers

O. L. Law
Goodyear Tire and Rubber Co.

W. Q. Gordon
Goodyear Tire and Rubber Co.
Dry Blend Compounding of Polyvinyl Chloride Resins

Norman Skow
Synthane Corporation
Laminates for Printed Circuits

Wm. Braham
Zenith Plastic Company
Asbestos Reinforced Plastic Manufacturing and Design Techniques

J. B. Thompson
E. I. du Pont Company

O. C. Turrell
E. I. du Pont Company
Coefficient of Friction of Teflon Against Steel

Clint Blount
Bakelite Corporation
Workhorse Plastics

W. J. B. Stokes, II
Stokes-Trenton, Inc.
Mold Parts of Hard Electroformed Nickel

Wayne Pribble
Pribble Plastics Products, Inc.
Engineering of Mold Design

Bowman Stratton
Auto-Vac Company
Vacuum Forming

Robert Hrudka
Chicago Molded Products
Modern Applications for Modified Styrene Sheet

Benjamin Sokol
Republic Aviation Corp.
Plastics for Aircraft Tooling

H. M. Patterson
General Electric
Mycalex

K. K. Fligor
Goodyear Tire and Rubber

R. J. McCutcheon
Goodyear Tire and Rubber
Compounding and Processing Copolymer Styrene — Resins for the Manufacture of Tough Rigid Plastics

Dr. V. Stannett
New York State University
Paper-Plastics Combinations

Irving Katz
North American Aviation Co.
Recent Advances With Isocyanates Base Resins

J. Formo
Minneapolis-Honeywell Regulator Co.

L. Bolstad
Minneapolis-Honeywell Regulator Co.

E. C. Bernhardt
E. I. du Pont de Nemours & Co., Inc.
Stock Thermocouples, Pressure Gauges, and Ruptured Discs for Use on Plastic Extruders

Ernest Moslo
Moslo Machinery Co.
Runnerless Molding

Oscar Sisman
Oak Ridge Nat. Laboratory
Plastics in the Atomic Energy Program

A. P. Landall
General Electric Co.
Mold Erosion Using Radioactive Tracer Techniques

Dr. J. A. Neumann
American Agile Company
Welding and Flame Spraying of Plastics

C. R. Stock
American Cyanamid Co.
International Standards Organization

Admiral Mack Angas
Princeton University
Feasibility of Reinforcing Prestressed Concrete With Fiberglass Tension Members

(Please turn to page 16)

J. E. Brister

L. J. Morrison

Robert F. Hrudka

Ernest P. Moslo

Committee Chairmen

CHARLES C. DAVIS, JR. is Chairman of Publicity and Liaison.

He graduated from Princeton University with a B.S. in Engineering. He spent seven years in the plastics business with Stokes Rubber Company, and is at present chief engineer of Stokes-Trenton Inc. which he helped to found in 1946.

He likes to watch football or hockey in his spare time.

EDWARD L. DEROWSKI is Chairman of the House Committee charged with making all the arrangements with the hotel for males, meeting rooms, and special services.

He graduated from Randolph-Macon College with a B.S. Degree and, after eight years with the Plastics Division of RCA, is now employed as shop superintendent with Penn-Plastics Manufacturing Company.

He spends his spare time fishing.

DONALD I. YARNALL is serving as Chairman of the Registration Committee charged with both soliciting and recording company and individual registration.

He attended Drexel Institute of Technology and Temple University, and is a member of the American Chemical Society as well as SPE. He has been with Rohm & Haas Company since 1935, and is currently concerned with sales of acrylic resin.

Tennis and shooting are his favorite sports.

Make Your Plans and
reservations NOW
for SPE'S 11th CONFERENCE!

Conference Program

(Continued from page 15)

J. J. Gouza
Rohm and Haas Co.
The Significance of Heat Distortion Temperature Measurements in the Evaluation of Thermoplastics

Wm. Gobeille
American Motorcar Co.
Selection of Plastics for Appliances

Sumner Raymond
Markem Machine Co.
Marking of Plastics

Lloyd E. Parks
Logo, Inc.
Color Paint and Plastic

W. F. Bartoe
Rohm and Haas Co.
A New Method of Studying the Outdoor Exposure Resistance of Plastics

E. G. Hansen
J. O. Ross Engineering Corp.
18 Successful Years of High Pressure Hot Water Process Heating in Plastics Plant

Wes Larson
DeBell and Richardson
Plastic Pipe

Kenneth H. Brockschmidt
Plastics Engineering
Molding Granulated Wood

R. E. Brannan
Bakelite Co.
New Applications of Old Materials

Alde Simmons
Plymouth Industrial Products
Fast Cycle Injection Molding of Low Cost Fiber Filled Compounds

S. K. Moxness
Moxness Tool Works
The Engineering of Silicone Rubber Parts

P. J. Wayne
E. I. du Pont de Nemours & Co.

W. M. Bruner
E. I. du Pont de Nemours & Co.
Bonding of Teflon

One of Panel Speakers

Carl Whitlock

A. P. Landall

Vivian T. Stannett

More Program Information

Summaries Of Material Scheduled For Speakers

Ed Childs, Monsanto, will begin the polyethylene panel discussion by reviewing the growth and present potentials of polyethylene in the fields of pipe, film, wire, bottles, laminates, and molded parts.

Compounding Polyvinyl Chloride Using The Powder Mix Technique

Mr. A. M. Medoro, Jr., Auburn Button Works, Inc., will begin with a historical review of vinyl processing methods and follow with a discussion of the compounding of polyvinyl chloride using the powder mix technique. Mr. Medoro will advise the processor on such points as equipment, material handling, coloring, extrusion and injection of dry blends.

Progress in Materials and Fabricating Techniques

John Benedito, Bakelite Co., will describe the properties that have made polyethylene a success in various applications. He will then discuss the progress that has been made in improving the properties of polyethylene by way of copolymerization, blending, and irradiating. This will be followed by a review of the primary fabricating techniques and the direction of improvements to increase efficiency or to create new products. The long range economics of materials and fabricating costs versus other packaging films, paper, glass, metal, and pipe will also be covered.

Molding for Quality

A prominent molder of houseware items will discuss the use of plant procedures and tests and the importance of industrial standards and recommendations to assure quality molding. He will also suggest material and process improvements that will help to broaden markets and create new uses.

What Makes the Sale

Charles A. Harper, Sears Roebuck and Co., will explain why polyethylene, compared with other plastics, enjoys such a wide consumer acceptance. He will then outline the opportunities for further sales expansion in terms of specific items, material and design improvements.

Properties and Characteristics of "KEL-F"

Jules A. Jupa, M. W. Kellogg Co., will review the physical properties of "Kel-F" and then discuss the importance of crystallization, dispersions, fillers, "Kel-F" inks, and "Kel-F" laminates. Hot runner molding of "Kel-F" will be described also.

Paper-Plastics Combinations

V. T. Stannett, State University of New York, will briefly describe the types of paper-plastic combinations and will stress the more recent developments in the application of plastics to paper. Low permeability of plastic coated papers to water vapor and other gases will also be discussed.

Mold Erosion Using Radioactive Tracer Techniques

A. P. Landall, General Electric Co., will describe the way his company attacked the problem of mold erosion by irradiating the sprue bushings of a transfer molding press. Results obtained from this test method may prove useful in developing molding powders which are lower in mold-wearing rates.

Injection Molding Machine Heating Cylinder

C. E. Beyer, R. B. Dahl, and R. B. McKee, Dow Chemical Co., will present a series of three papers covering (1) Temperature and pressure measurements in the heating cylinder, (2) Temperature variations in the heating cylinder, and (3) Design of heating cylinders. Theoretical aspects, test methods and results, and practical application will be discussed.

Going To Conference?

Here's Important Travel Information

Members of the Society, and others, attending the Conference should not fail to derive much additional benefit and pleasure by taking advantage of the highly organized transportation plan, which is being undertaken on a very wide scale this year.

The various railroads and airlines, serving the area where your section has its headquarters, have been asked to cooperate with the transportation chairman appointed by the President, so that special planes and trains may be scheduled wherever possible at a time convenient to the majority and routed directly through to Atlantic City.

For your convenience the transportation chairmen, who have already been appointed, are listed below. If you do not find one listed for your section, please contact your President or Vice-President.

Those sections, which have in the past been individually organizing their own group travel, can testify to the success of this group travel plan. You will find that it extends the pleasurable time spent at the convention.

(see next page)

For Group Travel Info

Contact Your Travel Chairman

Section	*Transportation Chairman*
Buffalo	H. Nathan 11 Covington Rd. Buffalo 16, N. Y.
Central Ohio	W. L. Croll c/o Hydraulic Press Mfg. Co. Mt. Gilead, Ohio
E. New England	Frank C. Dooley 31 St. James Ave. Boston 16, Mass.
Miami Valley	Carl Ackerman 1814 Adams Rd. Mt. Healthy, Ohio
Milwaukee	Jack H. Godfrey Sunlite Plastics 1512 W. Pierce St. Milwaukee 46, Wis.
New York	William Lewi Dusal Tool & Mold Co. 37-01 Vernon Blvd. Long Island City, N.Y.
Ontario	M. W. Wilkinson 1303 Yonge St. Toronto, Ont.
Pittsburgh	J. B. Schmidt Koppers Co., Inc. Koppers Bldg. Pittsburgh 19, Pa.
South Texas	Lewis C. Connelly Eastman Chemical Prods. Co. 1001 State Nat'l. Bank Bldg. Houston, Texas
Toledo	Donald R. Bowlin 1306 Asbury Drive Toledo 12, Ohio
Upper Midwest	R. K. Erickson Kenson Inc. 6012 Wayzata Blvd. Minneapolis 16, Minn.
W. New England	Richard J. Plichta Fuller Brush Co. Hartford, Conn.
Other Sections	The President or Vice President

Colors, Paint, and Plastic

Lloyd E. Parks, Logo, Inc., will give a detailed account of the use of paint on plastics. The development of a paint formulation as a coating for plastics will be discussed as well as the methods of painting plastics such as spraying, silk screening, printing, etc. and the problems involved such as adhesion, humidity blush, pinholing, etc.

General Principles of Mold Temperature Control

A representative from Sterling, Inc., will discuss the results that can be obtained by keeping mold surfaces at the best temperatures. The methods of a heat transfer fluid and some of the fundamental considerations of design and operation of equipment for delivering heat transfer fluid at a constant and controlled temperature to the mold will be covered.

Applications of Silicone Rubber

Mr. S. K. Moxness, Moxness Tool Works, will give a short resume of present and probable future applications of silicone rubber in molded or extruded shapes in the aircraft, electrical and other industries.

Vacuum Forming

Mr. E. B. Stratton, Auto-Vac Co. will discuss the various methods of vacuum forming cellulose acetate, vinyl copolymers, styrene copolymers, acrylics, polyethylene and nylon. Developments, future improvements, and a comparison of the methods now in use will be covered as well as the control of heating, forming speed, and cooling for all types of vacuum forming.

New Applications of Old Materials

R. E. Brannan, Bakelite Co. will cover some of the past experience in developing uses for phenolic resins such as flat iron handles, radio and TV cabinets, and washing machine agitators. Finding new applications in the oil industry (micro-balloons) and the furniture field will then be described.

Plastics in the Atomic Energy Program

Oscar Sisman, Oak Ridge National Laboratory, will give an account of life among the hot plastics. The use of high energy radiation to induce changes in plastics, the mechanism of radiation effects, and the physical properties of irradiated plastics will be described.

Mold Parts of Hard Electroformed Nickel for Molds for Plastics

W. J. B. Stokes II, Stokes-Trenton, Inc., will describe the method of manufacture and the properties of electroformed cavity parts. The unusual mold construction details permitted by using the electroforming process and the limitations of electroformed cavity parts will also be discussed.

(Please turn to page 46)

To Discuss Paint on Plastics

Lloyd E. Parks

Another new development using

B. F. Goodrich Chemical *raw materials*

B. F. Goodrich Chemical Company does not make these highway signs. We supply the Geon resin only.

Sign language for safer highways!

HERE are the signs of tomorrow—made from high impact Geon rigid vinyl.

Your highways will be safer with these improved signs because the safety signal is clearly seen year after year without replacement.

Bend one—it recovers its shape. Hit it a whack—it won't chip. Heat, cold, sunlight won't affect it—and it can't rust.

Even more remarkable, message and border are *molded* with a 3-dimension effect above the background with surfaces permanently reflectorized for high visibility at night.

This is just one example of how Geon polyvinyl materials can help turn your ideas into a sales success. Geon's versatility is shown in such products as rustproof piping, permanent window screening, lifelike dolls, weatherproof fabric and high quality electrical insulation.

Let us help you select a Geon material that may expand markets or open new ones for you. For information, please write Dept. SPE, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

standard HPM MOLDS BAKELITE C-11 TO CRITICAL TOLERANCES!

Norgren Vitalizer Unit, a combination air line filter and oil fog lubricator. Heavy, durable, transparent bowls and baffle are molded by Chaney Plastics of Denver.

Chaney Plastics of Denver Solves Tough Production Problem with Standard H-P-M Injection Machine.

Here's one to remember . . . when quality and dimensional tolerances are critical and molded parts undergo rigid inspection, you can rely on standard H-P-M injection machines to handle the job. In this instance, the Chaney Plastic Molding Co. of Denver, installed a new H-P-M 9 oz. and within two hours after installing the dies were producing quality bowls for the C. A. Norgren Co. This, in itself, must be some sort of record, for both machine and dies were new. The bowls are designed with an 8X safety factor, are .300" thick, Bakelite C-11 material. One of the bowls has a brass insert in the bottom. Critical dimensional tolerances are maintained.

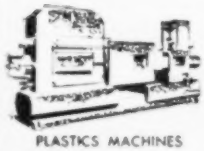
It's another typical H-P-M success story — one that may have a parallel in your plant. If you've an injection molding problem you can be sure there's an H-P-M for the job. Get in touch with your H-P-M field engineer today.

HPM

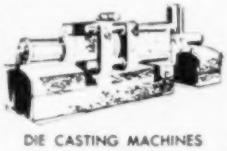
THE HYDRAULIC PRESS MFG. COMPANY

3015 Marion Road, Mount Gilead, Ohio, U. S. A.

METAL WORKING PRESS

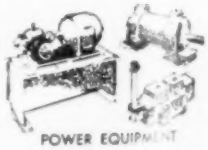


PLASTICS MACHINES



DIE CASTING MACHINES

C—PRESSES



POWER EQUIPMENT

The concept of Control Charts . . . . Part II

Delmer C. Dague
Quality Control Engineer
The Hoover Co.

and

John D. Hinchen
Quality Supervisor
Monsanto Chemical Co.

This second article on control charts is the fourth in a series on statistical quality control for the plastics molder, written by the Statistical Quality Control Committee of the Society of Plastics Engineers, under the chairmanship of L. M. Debing.

Introduction

The control of quality in many production processes is not readily adaptable to the control chart treatment discussed in the last article. For example, if an item is produced in extremely large numbers, it may be very expensive or time consuming to measure its quality characteristics, even though we are still interested in whether the item can be considered as good or bad. Often in such cases, the testing is done by means of a "go-no go" gauge when a dimension is involved, or by comparison with a standard of acceptability when another quality characteristic is being determined. In other situations we may be inspecting a complex item or assembly for the presence of more than one given defect, and as in the cases above, we are interested primarily in whether or not the defect is present. In the manufacture of a molded radio cabinet, for example, we are interested in whether the finished cabinet can be shipped to the radio manufacturer. Surface smoothness, visible contamination, lines of flow of the mottle pattern, color, flash thickness, positioning of inserts (if any), dimensions of openings, warpage, and the like, are some of the things for which the inspector checks the molded article. He is not necessarily concerned with a precise measurement of each of these things, but rather, whether these characteristics, individually or taken together, cause the piece to be unsatisfactory for shipment.

The previous article discussed quality characteristics which can be measured, and which we called "*variables*". The problem of control of quality in an operation like the radio cabinet job concerns itself with what we call "attributes". Quality control of *variables* is concerned with the question "how much?" or "to what extent?" does the quality characteristic exist. Quality control of attributes is concerned with the presence or absence of a given characteristic or defect. The acceptability or rejectability of a molded radio cabinet is considered an attribute of that cabinet.

The Basic Assumptions

It is difficult to see, at the outset, how the presence or absence of a given characteristic can be used to determine trends or changes in the state of control of a given process. It is true, that if each individual item is considered alone, then the item is either good or bad, and the only obvious improvement in quality is the complete elimination of all the defects. We all know that such perfection is practically unattainable. How then can we measure improvement, or know when the control of product quality changes?

If we consider the number of defective items in a given number of items, we have a quality index which will permit the use of techniques for separating the expected variation of quality from the variation which indicates a change in the state of control. In the preceding article, we observed that the distribution of averages of measurements could be represented by the Normal Frequency Distribution curve, and made use of the mathematics of that curve to determine whether the process was behaving as expected. Under certain limited conditions, the number of defective items in a group of items can be considered as a normally distributed quality, but in order to handle the majority of cases met in industry, it will be necessary to develop another distribution which can be applied more generally.

What we are interested in is finding a frequency distribution which will represent the amount of variation from sample to sample, of the number of defective items or defects occurring in a process which is operating in a fixed state of control. This variation would then represent the chance variation of the process, the differences to be expected from sample to sample due to chance alone.

Perhaps it will be possible to set up a model process by which we may arrive at the answer we seek. Suppose we had, in a large container, some hundreds of thousands of colored beads, some of which were black and some of which were white. If we consider each black bead as a defective item, and each white bead as a good item, this container of beads can be compared to the possible manufactured pieces in a production operation. A random sample taken from this "*population*" can be compared to a number of molded pieces taken at random from a molding machine's production and inspected to determine whether each piece is good or bad.

DISTRIBUTION AND SAMPLE SIZE

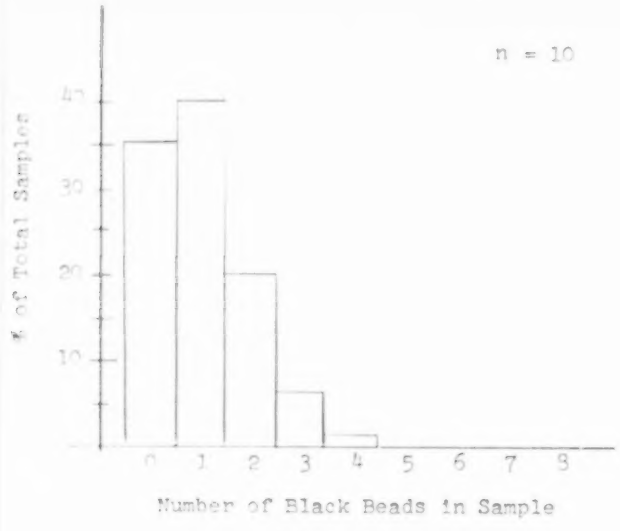


Fig. 1

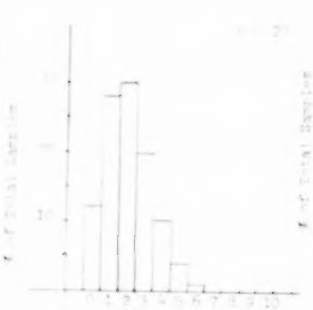


Fig. 2

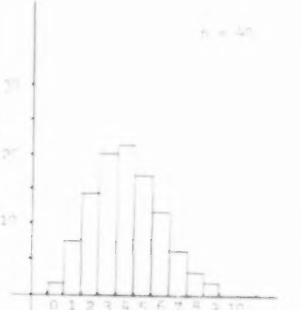


Fig. 3

Suppose in the model process we have set up, we were to have distributed among the white beads, black beads in the amount of 10% of the total number of beads. A random sample of ten beads might be expected to contain 10% black or 1 black bead. We know, however, that we would not obtain exactly one black bead in every sample of ten. Sometimes we would have more and sometimes less than one. The variation in the number of black beads present from sample to sample is the *"chance"* variation of the distribution of the beads. In any production process where we are counting defective items or pieces in a sample of several pieces, this same type of chance variation occurs, and it becomes our problem to separate chance or expected variation from the variation that indicates a change in the state of control. In the previous article we made use of the Normal Distribution as already mentioned. Let us see what kind of a distribution we can build up from this model process.

Continuing the sampling of these beads, ten at a time, we can plot a frequency histogram showing the number of times we find no black beads in the ten, one black bead, two, three, four and up to ten black beads in the sample. This has been done many times in courses on Statistical Quality Control, and Figure 1 shows the type of distribution obtained.*

As shown by the histogram, about 40% of the time we may expect to find exactly one black bead, or defective item in the sample of 10, and the chance of finding five more black beads is very small. However, our chance of obtaining 30 or 40% defective items in the sample is too large to be ignored. If we were interested in knowing whether someone had added more black beads to the population, we might make such a decision based on a sample of 10, when it really was only chance variation present. One way of decreasing the probability of making such a wrong decision is to include more items in the sample and Figures 2 and 3 show the distributions which would build up for samples of 20 and 40 beads respectively.

As the sample size increases, the distribution becomes more symmetrical, and as the sample size increases indefinitely, the distribution approaches as a limit the Normal Frequency Distribution.

There is a mathematical expression for the histograms derived above. This expression is known as the Binomial Expansion, and the distribution so obtained is called the Binomial Distribution. For the mathematically inclined, the relative frequency of samples containing **r** defective items in a large number of samples is given by the expansion of the binomial

$$(p + q)^n$$

where **n** is equal to the number of items in the sample (sample size), **p** is the expected proportion of defective items in the sample, and **q** is equal to **1-p**. The value of **r** can vary from o to n, and the terms of the expanded binomial tell us how often to expect 0, 1, 2 . . . . . defective items in the sample. In our bead experiment, p was set at 0.10, and we constructed histograms for n = 10, n = 20 and n = 40.

The calculation of the terms of the binomial expansion are quite tedious for sample sizes larger than 10, with the amount of arithmetic increasing astronomically as the sample size goes up. Fortunately the mathematicians have done a good deal of calculation for us, and tables of the Binomial Distribution are available for our use.

Calculation of Control Limits

The transition from the frequency distribution to a system of control charts, is handled in a similar manner to the X and R charts. The basic distribution establishes the pattern of variation to be expected from the process, and the operation is considered to be "in control" as long as the variation does not exceed this pattern in degree or differ from it in some other way.

If the value of **p** is close to 0.50, and n is sufficiently large, the distribution of the number of defects is reasonably close to the normal frequency distribution. In such cases we can calculate the average and 3 σ limits for the distribution, and use these factors on control charts as we did for the control charts for variables. The standard deviation may be calculated directly from the data by the formula

$$\sigma = \sqrt{\frac{\Sigma X^2 - (\Sigma X)^2 / N}{N - 1}}$$

where **X** is the number of defectives in a given sample and **N** is the total number of samples taken.

A simpler method for calculating the standard deviation is available. The Binomial Distribution differs from

*Note: *If the reader performs this experiment, each sample should be returned to the container and mixed, to avoid changing the proportion of black to white beads.*

the normal in that the variation is dependent on the average. The average number of defective items in samples of n items is equap to **np**, where **p** is the probability of one item being defective. The standard deviation

$$\sigma = \sqrt{n p (1 - p)}$$

The use of the standard deviation as a measure of variability is only approximate unless the sample size is sufficiently large so that the distribution is symmetrical. For small samples, or low values of **p** which give an appreciably skewed distribution, the probability limits of chance variation are not balanced, and should be obtained from the Binomial Probability Tables (3).

Let us assume that a production process is turning out items which are being checked on a go-no go gauge for a given dimension. The machine is producing 100 units per hour, and the number of items not meeting the gauge tolerances are recorded each hour. The tally sheet may look something like this:

Date	Time	No. Items Checked	No. Items Defective
8/14	8:00 AM	100	6
8/14	9:05 AM	100	8
8/14	9:55 AM	100	6
8/14	10:55 AM	100	2
8/14	12:00 M	100	7
8/14	1:15 PM	100	9
8/14	2:05 PM	100	5
8/14	3:00 PM	100	6
8/14	4:00 PM	100	7
8/14	4:55 PM	100	8
8/14	6:30 PM	100	5
8/14	7:20 PM	100	4
8/14	8:15 PM	100	9
8/14	9:00 PM	100	3
8/14	10:05 PM	100	6
8/14	11:45 PM	100	7
8/15	12:50 AM	100	5
8/15	2:00 AM	100	3
8/15	2:55 AM	100	8
8/15	4:00 AM	100	6
8/15	5:00 AM	100	7
8/15	6:10 AM	100	5
8/15	7:00 AM	100	6

Using these data as representative of the process, we may proceed to calculate the mean and standard deviation. The mean or average number of defective items per 100 units is obtained by adding the total number of units rejected, and dividing by the number of samples taken. The mean for the data calculated above is 5.8.

We have used the term p to represent the probability of an individual sample being defective. The best estimate of this probability can be obtained by dividing the average number of defects per sample by the number of items in the sample. In the example above,

$$P = 5.8 \div 100 \text{ or } 0.058$$

In order to calculate the standard deviation for this set of data we revert to the formula mentioned previously:

$$\sigma = \sqrt{n p (1-p)}$$

$$\sigma = \sqrt{(100)(.058)(.942)}$$

$$\sigma = 2.33$$

The control limits for the number of defective items per sample of 100 in this case is given by $X \pm 3\sigma$ or $X \pm (3)(2.33)$.

These limits then would be 0 to 12.8. In other words, if this process continued to operate in the same state of control that existed when the data were collected, we would expect 99.73% of all the samples to have between 0 and 12.8 defective items.

Fraction Defective

In many operations, it is not always possible to select a constant sample size, or for other reasons it may be more convenient to think in terms of the percent or fraction defective in a sample. In the example given above, we might consider the data collected in such terms, so that our fraction defective figures for the individual samples are 0,06, 0,08, 0,06, 0,02 etc. The average fraction defective for the distribution is obtained by dividing the total number of defective items obtained by the total number of items examined. Thus:

Average fraction defective = 138 ÷ 2400 = 0,058.

The standard deviation for fraction defective is obtained as follow:

$$\sigma = \sqrt{\frac{(p)(1-p)}{n}} = \sqrt{\frac{(0{,}058)(0{,}94)}{100}} = 0{,}0233$$

and the control limits are 0,058 ± 3(0,0233), or 0 to 0,128.

It will be readily seen from this formulation, that the variation in sample fraction defective is inversely related to the sample size, so that for very small samples, the range of chance variability is quite large, while large samples give precise estimates of quality with very little inherent error.

As we mentioned before, it may not always be possible to limit the sample size to a definite figure. Variations in production rate, manpower requirements in the inspection department, the state of control of the process itself may demand variations in sample size. Suppose in the operation just considered, we had to go through a period in which the sample size varied between 50 and 200 over a period of time. The data thus collected might have been tallied in the following manner:

Sample	Sample Size	Number of Defects	Fraction Defective
1	50	3	0,06
2	50	2	0,04
3	50	5	0,10
4	50	1	0,02
5	50	2	0,04
6	50	2	0,04
7	50	4	0,08
8	50	3	0,06
9	100	5	0,05
10	100	7	0,07
11	100	6	0,06
12	100	3	0,03
13	100	4	0,04
14	100	9	0,09
15	100	6	0,06
16	100	6	0,06
17	200	10	0,05
18	200	9	0,045
19	200	7	0,035
20	200	12	0,06
21	200	14	0,07
22	200	15	0,075
23	200	9	0,045
24	200	11	0,055
Total	2800	155	

Ave. Fraction Defective = 155 ÷ 2800 = 0,054

The control limits will differ for each portion of the production, since the standard deviation depends on the

(Please turn to page 52)

Every man owes some of his time and support to the upbuilding of the profession to which he belongs or which furnishes him with a living.

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J. P. Healey
Chairman of the
National Membership Committee SPE

SOCIETY OF PLASTICS ENGINEERS, INC.

National Executive and Business Offices

Suite 116 34 East Putnam Ave.

Greenwich, Conn.

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By advancing the theory and practices of engineering and the allied arts;

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IV. For the recognition of plastics engineers within the industry and enhances the status of the plastics engineering profession in general.

V. An unbiased source for the dissemination of technical information on plastics. Some of the committees doing this dissemination are:

EDUCATION: This committee, composed of at least twelve men, six from industry and six from educational institutions, set up a standard program for educational requirements for an advanced degree in plastics engineering. It is cooperating with industry and educational institutions to define the requirements expected in a plastics engineer.

PROFESSIONAL ACTIVITIES: This committee compiles bibliographies, sets up test procedures and works on specific problems of the plastics engineer.

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Professional Member	Ten or more years
Member	Five or more years
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Education may be substituted for experience on the following scale:

Degree	Years
In a field other than engineering or a physical science.	Two
BA or BS in engineering or a physical science.	Four
MA or MS in engineering or a physical science.	Five
PhD in engineering or a physical science.	Seven

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Fiscal year: July 1 through June 30.

Initiation fee must accompany application

Dues will be invoiced after election to membership

	Initiation Fees	Annual Dues
Professional	$10.00	$12.00
Member	10.00	12.00
Associate	10.00	12.00
Junior	5.00	7.00

Dues First Year

If elected 1st quarter—full year
If elected 2nd quarter—¾ year
If elected 3rd quarter—½ year
If elected 4th quarter—¼ year

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Gentlemen:

I hereby make application for membership in the Society of Plastics Engineers, Inc. on the basis of my training and experience as set forth herewith. I prefer to affiliate with the _____ Section. (Geographical Location)

I certify that the statements made in the record of my training and experience are correct. I agree, if elected, to be governed by the Constitution, By-laws and Rules as long as my connection with the Society shall continue. I agree to promote the objects of the Society as far as shall be within my power.

Date _____ Signature in ink.

REFERENCES

To whom may we write for information? Please give the names of at least three men who are familiar with your work. Two of them should be members of the Society.

1 _____ Address _____

2 _____ Address _____

3 _____ Address _____

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Applicant's Full Name _____

Please fill in both addresses and check which one mail should be sent to.

☐ (Business) Company Name: _____

Street No. _____ Street: _____ City: _____ Zone No. _____ State: _____

☐ (Home) Street No. _____ Street: _____ City: _____ Zone No. _____ State: _____

APPLICANT: Do not write below this line on this side. **COMPLETE BOTH SIDES OF THIS APPLICATION**

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Submitted to Section Credentials Committee Date _____

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Education _____
Experience _____
Total _____

This man is classed as a:
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Date processed _____

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Degree of from date

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Explain in detail, the nature of your work and responsibilities

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In the space below, supply complete record of past connections in detail. Describe duties fully and state briefly any important engineering work you have done. If space is not sufficient continue record on separate sheet of same size. **Your proper classification depends greatly upon the clarity of your record of experience and the degree of technical knowledge or skill required.**

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COMPLETE BOTH SIDES OF THIS APPLICATION AND MAIL WITH INITIATION FEE TO S.P.E. OFFICE.

Printed in the United States

measurement of creep of acrylic glazing plastics exposed to temperature gradients

Murray C. Slone and
Frank W. Reinhart
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Washington, D.C.

ABSTRACT

A method is described for measuring the creep of transparent plastic aircraft glazing materials under tensile stress with substantially different temperatures on each face. The equipment, designed and built at the National Bureau of Standards, is described in detail. The operating procedure and methods of calculating the elongation (strain) and creep rate are presented. The results of tests made with two acrylic plastics, UVA Plexiglas II and Plexiglas 55 are reported. A statistical analysis of the results is given. The results indicate that the test is valid and sufficiently reproducible to distinguish between materials.

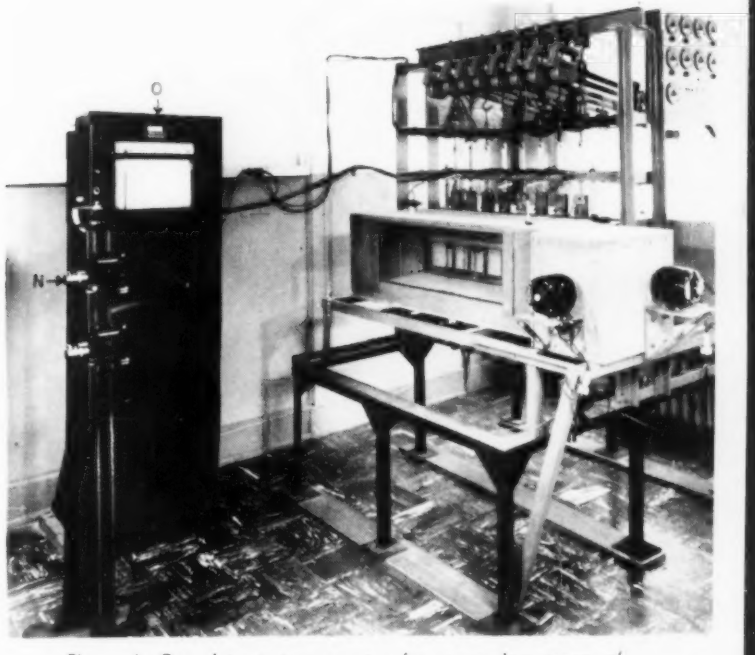

Figure 1. Complete test apparatus for measuring creep of transparent plastics.

Introduction

There is no information available on the creep of transparent plastics under the conditions encountered in aircraft glazing applications. These materials are subjected to stress while the temperatures of the two faces are markedly different. This results in an appreciable temperature gradient from one face to the other. A project to obtain information of this type was undertaken at the request of the Airborne Equipment Division, Bureau of Aeronautics, Department of the Navy.

A testing program was designed to evaluate the behavior of transparent plastic aircraft glazing materials at several mean temperatures, temperature gradients, and stresses. On the basis of work previously done by the Goodyear Aircraft Corporation for the Department of the Navy(a), the following temperature schedule was established:

Mean temperature F	Temperature gradient ±° F
160	0, 30
180	0, 30, 40, 50
190	0, 40
200	0, 50

In the above table and throughout this report, temperature gradient is expressed as the deviation of each surface temperature from the mean temperature. For example, 180° ±30°F indicates surface temperatures of 150° and 210°F. At each set of temperature conditions, duplicate specimens were loaded in tension under stresses of 500, 750, 1000, and 1500 lb/in². The tests were not made in the order indicated in the above table, but were randomized in a different order for each material. This randomization is a recognized statistical method of approach to a series of measurements such as this.

Materials and Sampling

Materials studied were: (1) UVA Plexiglas II Rohm & Haas Co., Heat-resistant ultraviolet absorbing acrylic, one sheet, 0.375 in. thick; annealed 5 hr. at 100°C, 18 hr. slow cooling; and (2) Plexiglas 55, Rohm & Haas Co., Modified acrylic, two sheets 0.395 in. thick; annealed 5 hr. at 95°C, 18 hr. slow cooling.

Since the UVA Plexiglas II specimens were all cut from one sheet, they were nonselectively paired for duplicates. The Plexiglas 55 specimens were grouped in sets of two so that in half of the tests, duplicate specimens were taken from the same sheet, and in half the tests, duplicates

(a) *Goodyear Aircraft Corporation Report No. 1957 entitled: "Evaluation of Current Type Acrylic Canopies at Elevated Temperatures," by Smithers, Frauenfelter, and Dunmire.*

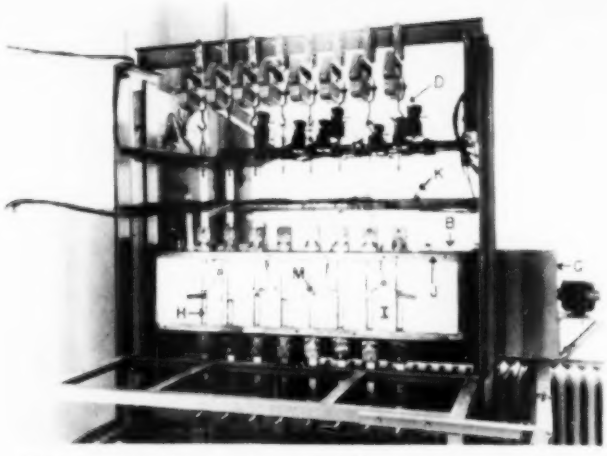

Figure 2. Rear heating box unit with specimens in position.

were taken one from each of two different sheets. No part of the test section of any specimen was less than one inch from an edge of a sheet. The specimens were annealed prior to testing according to the schedule in table I.

Specimens

The specimens were similar in design to a standard tensile specimen(b). The over-all length was 15 inches, the width of the ends 1 inch, and the length of the ends 1.5 inches. The reduced section was 0.5 inch wide by approximately 10 inches long. The radius of curvature of the fillet was 3.0 inches. The material, received in sheet form, was cut with a band saw into 1 by 15 inch strips. These were machined to the finished dimensions by a milling cutter. The gage length was approximately 6.5 inches. A red printers' ink was used for the gage marking material. This ink was in paste form, adhered well to the specimens and had sufficient consistency that it did not sag when the specimen was in a vertical position. It did not dry, crack, or shrink at the temperatures used in these tests.

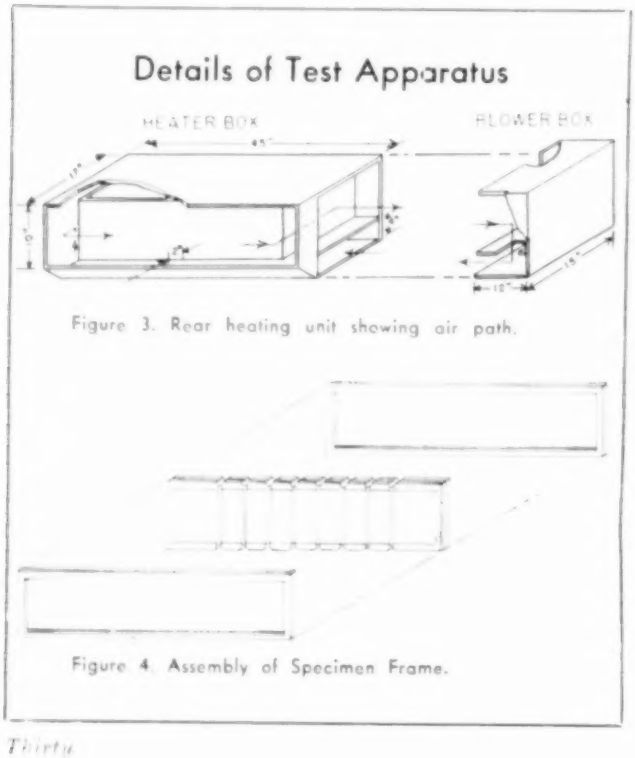

Figure 3. Rear heating unit showing air path.

Figure 4. Assembly of Specimen Frame.

Apparatus

The design of the test apparatus is based on the principle of continuous circulation of air at controlled temperatures over the surfaces of the specimens. Two separate heating units are used with eight specimens between them. An insulation barrier prevents the air at the two different temperatures, from traveling from one unit to the other. Each unit has a chamber in the bottom containing electrical heaters. A pair of blowers operates continuously, but a bimetallic thermoregulator in the air stream controls the operation of the heating elements. The bottom ends of the specimens are clamped to the supporting framework while the top ends are clamped to weigh beams. Sliding weights on the weigh beam arms provide the desired stress. The test apparatus is shown in figure 1. A more detailed description of the apparatus is given in the following paragraphs.

A view of a set of specimens, H, backed by the rear heating box, B, and loaded by means of weigh beams, D, is shown in figure 2. The specimens, H, are held loosely in the frame, J, and are clamped at each end. The heated air flows from the left in the heater box, B, between the specimens and an air barrier in the heater box into the blower box, C. The insulated spacers, I, prevent the passage of air and heat from box to box. The frame does not restrict the movement of the specimens and is hung by straps, K, so that none of its weight is on the specimens. A thermocouple on each face of the specimen, is held lightly in place by a spring faced with a felt pad, M. The front panel and the air barrier in the forward heating box are glass to enable the operator to observe the specimens. See figure 1. The change in length of the specimens is measured by sighting through the glass front with the cathetometer, N, and measuring the movement of the gage marks. A fluorescent lamp in each heater box makes it possible to observe the gage marks. When a specimen elongates to a point where the weigh beam arm falls on the back rest, the beam strikes a microswitch which stops a clock.

The temperatures are continuously measured on a 16-point millivolt recorder, O. The electrical connections, switches, relays, and fuses for operating the test equipment are located in the control panel, P.

Figure 3 is a schematic view of the rear heating unit showing the heater box and the air blower box, the air flow path and the over-all dimensions. The blowers force the air from right to left across the heaters in the bottom of the heater box. The air flows upward past a thermoregulator at the left end and is drawn between the air barrier and the specimens to the blowers. The floors of the two boxes are at the same level and a seal is provided so that the air cannot be short-circuited in the blower box. The boxes are constructed of Transite sheet mounted on a brass angle frame, and are lined with asbestos paper. The lower front section of the heater box is sloped to facilitate handling of the specimen clamps which are very close to the box. The forward heating unit is a mirror image of the rear heating unit except for the outer face which is two panes of glass separated by a one-inch dead air space and the air barrier which is a single pane of glass. The blower motors, shown in figure 1, are externally mounted with their drive shafts extending into the boxes. Each fan rotor is housed in a cage to channel the air in the correct direction.

The specimen frame assembly is shown in figure 4. The two outer pieces in figure 4 are frames which

(b) *Figure 1 in A.S.T.M. D 638-52T Tentative Method of Test for Tensile Properties of Plastics.*

made of brass strips, one inch wide and $\frac{1}{8}$ inch thick, and lined on the inner side with wool felt. The center section in figure 4 shows the pieces of brass sheet which are placed between the specimens to prevent the travel of air from one box to the other. These pieces of brass sheet are faced along the top and bottom of the faces with felt strips to match the outer frames. The rest of each face is covered with asbestos paper to reduce heat transfer and to make the panels equal to the specimens in thickness. The side edges of the spacers are also covered with a strip of felt to provide loose but fairly airtight seals next to the specimens. The two frames and the pieces of sheet brass are fastened together with screws. The layers of felt serve to keep the front and back frames far enough apart to allow the specimens freedom of movement.

Procedure

The specimens are placed in the specimen frame, and the frame assembly is placed between the two heater boxes. The specimens are clamped in place and the thermocouples are connected to their respective junction posts. The heaters and blowers are turned on, the apparatus is allowed to come to the desired temperature conditions and is held there for approximately one hour to reach a steady state. The gage lengths of the specimens are measured by the cathetometer, and the loads are then applied. At one hour and periodically thereafter, the gage lengths are again measured.

Calculations

The measured changes in gage length are converted to percent elongation, and the values for duplicate specimens are averaged. The average values are then plotted for the four stresses at each temperature condition on an elongation-log time plot. The data for each stress could be represented by a straight line. Examples are shown in figures 5 and 6. In most cases the values for the duplicates were consistent enough so that they could be represented by a single line.

The creep rate, defined as the rate of change of elongation (strain) with respect to time, is derived mathematically in the following manner:

$$C = \text{creep rate} = \frac{ds}{dt}$$

where

s = elongation (strain)

t = time

On the straight line portion of the elongation-log time curves, the slope, m, is

$$m = \frac{ds}{d \log t}$$

$$\text{or } C = m \frac{d \log t}{dt}$$

$$d \log t = \log e \, dt \cdot t = 0.434 \, dt \cdot t$$

$$C = m (0.434 \, dt \cdot t) \, dt$$

$$\text{or } C = 0.434 \, m \cdot t$$

This equation shows that if m is constant, as is the case for the straight lines on the graphs, the creep rate will vary inversely with the time. In this work, the minimum creep rate will occur at the end of the test which is 50 hours, and then

$$C = 0.00868 \, m$$

$$\text{or } C = 0.00868 \, ds \cdot d \log_{10} t$$

It is very convenient to calculate $d \log t$ over the range of 5 to 50 hours. In this way, $d \log t$ or $\log t_2 - \log t_1$ becomes $\log t_2 - t_1$, or $\log 50 \cdot 5$, or $\log 10$, or 1, and the minimum creep rate can be calculated very readily by measuring the change in elongation between 5 and 50 hours on the curve. The minimum creep rate finally becomes

$$C = 0.00868 (s_2 - s_1)$$

Results

The values of elongation at 50 hours for the UVA Plexiglas II and the Plexiglas 55 are presented in table I (a). The results for the minimum creep rate calculated from the elongation-log time curves are presented in table II. The results of elongation and creep rate are presented graphically in figures 7 through 10. No attempt is made to draw curves through the various values, but it is readily seen what the general shape of such curves would be.

(a) The values of elongation in table II and minimum creep rate in table III are reported to the nearest 0.01 and 0.0001 respectively. It should be noted, however, that the error in reading the elongation with the cathetometer may cause an uncertainty in these values of as much as 0.005 for the elongation and 0.00005 for the minimum creep rate.

Results of Elongation Tests on Plexiglas

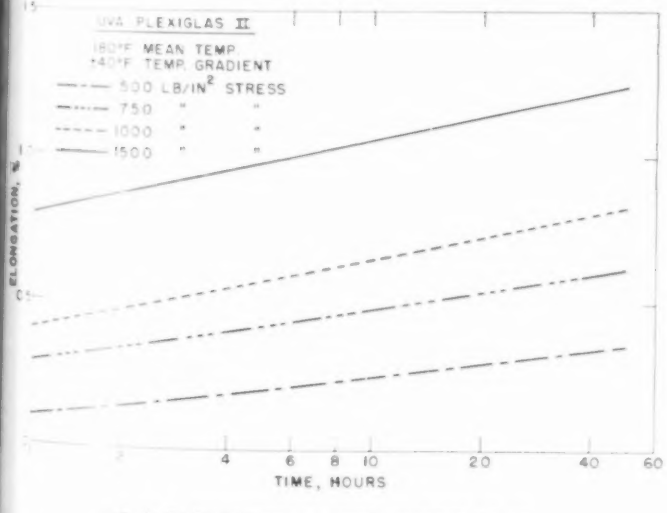

FIG 5 ELONGATION OF UVA PLEXIGLAS II

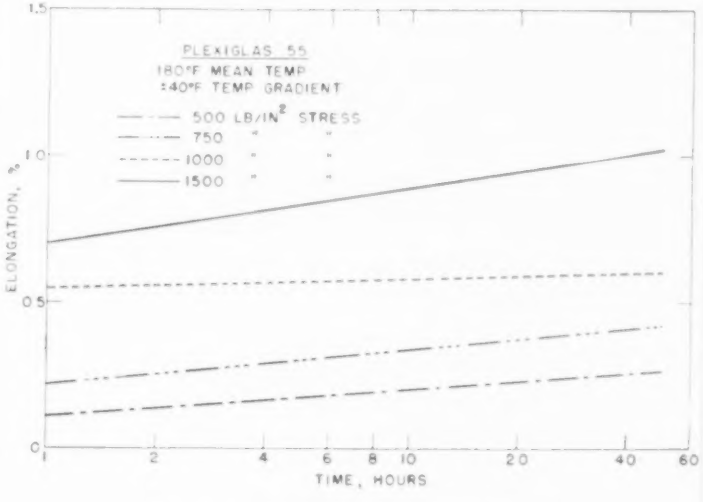

FIG 6 ELONGATION OF PLEXIGLAS 55

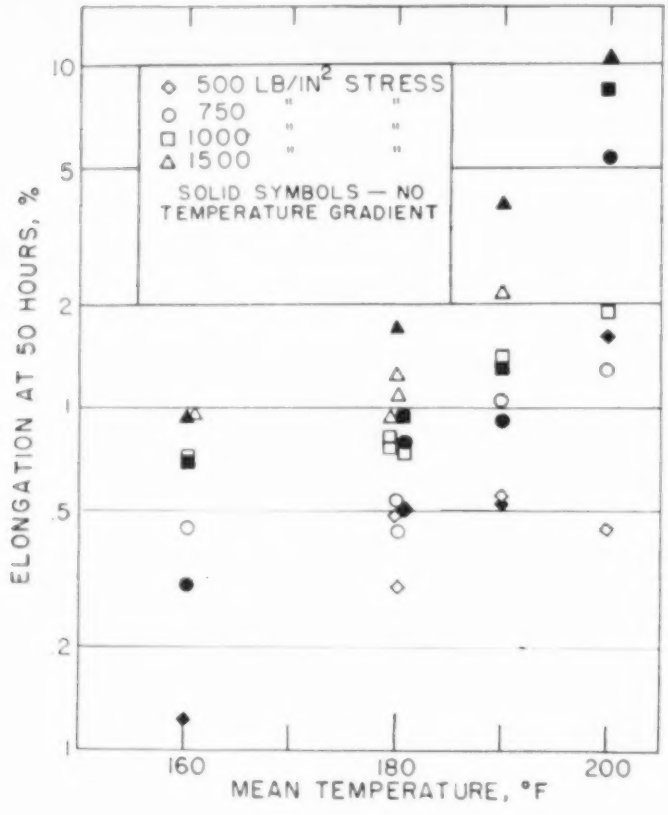

FIG. 7 ELONGATION OF UVA PLEXIGLAS II AT 50 HOURS

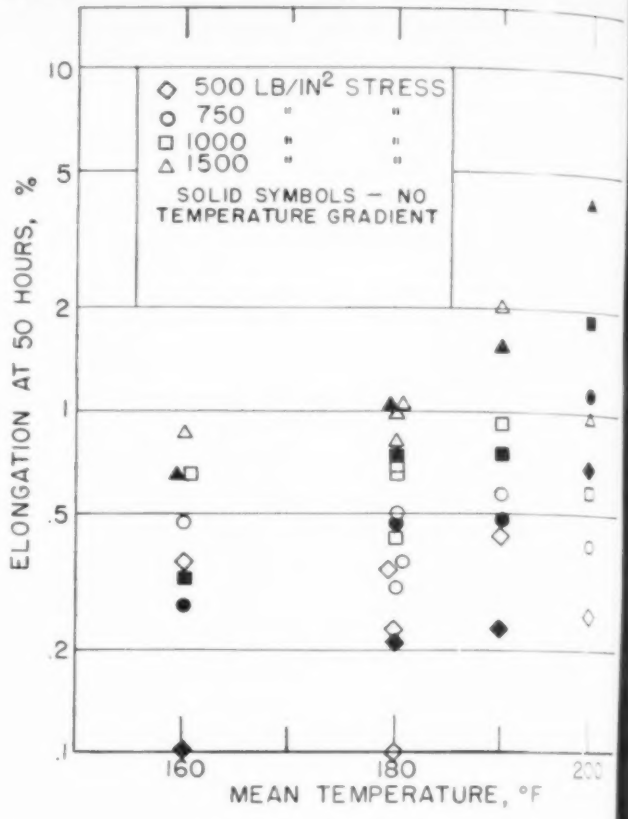

FIG. 8 ELONGATION OF PLEXIGLAS 55 AT 50 HOURS

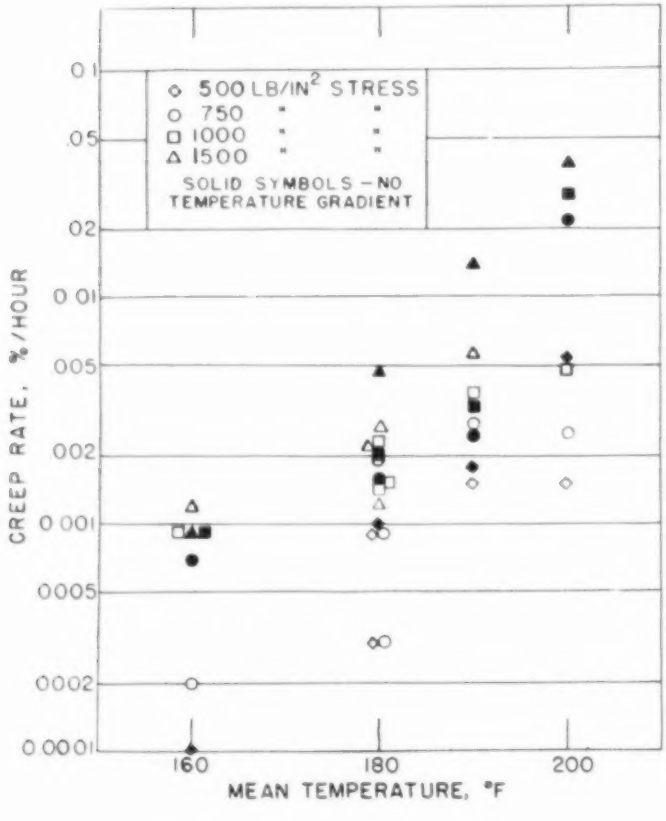

FIG. 9 MINIMUM CREEP RATE OF UVA PLEXIGLAS II

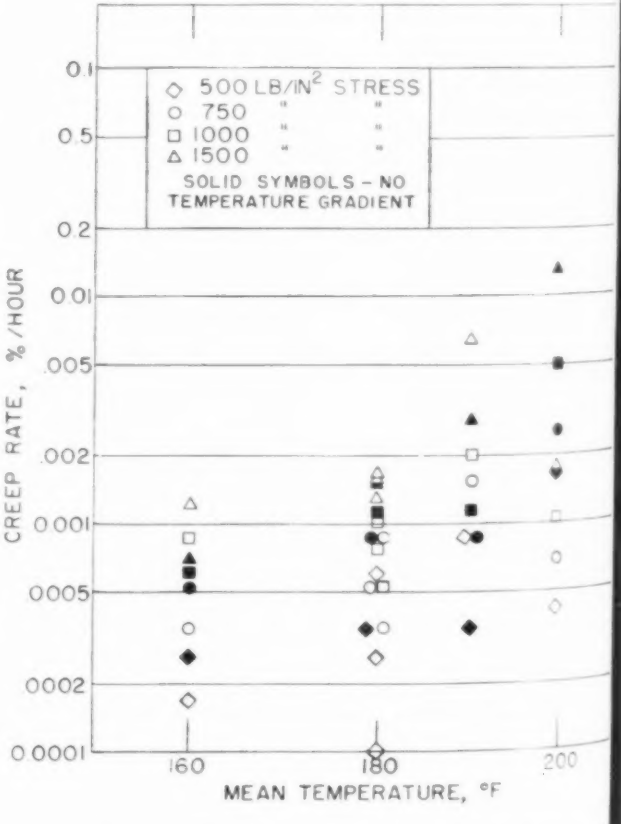

FIG. 10 MINIMUM CREEP RATE OF PLEXIGLAS 55

Comparison of UVA Plexiglas II and Plexiglas 55

One of the simplest methods of comparing two materials is to calculate the ratios of the corresponding values of elongation and creep rate. These ratios are given in Table III and from these data it would appear that Plexiglas 55 is the superior material for these properties, particularly at the higher temperatures. This type of method of comparison has the disadvantage of giving undue weight to the low range values in that two low range values differing by a small amount may have a large ratio value while two high range values differing by the same small amount may have a ratio value of approximately 1.

A different approach in comparing the two materials is to plot the elongation of one material versus the corresponding elongation of the other material and to calculate mathematically the slope of the straight line best fitting the plotted points and passing through the origin. This procedure is valid statistically only if the relationship between the corresponding materials is linear and independent of the conditions. Furthermore, a rigorous application of the method would involve a weighting procedure that would require a knowledge of the precision of the data in different ranges. If UVA Plexiglas II is used as the reference material and it is assumed that equal precision is obtained over the entire range of values, the slope of the line is 0.31. Plexiglas 55 is indicated as the superior of the two materials; this agrees with the result obtained by the previous method of comparison.

Neither of these two methods discussed is sufficient to give an accurate indication of the scatter of the results and consequently of the validity of the comparison. By far the best method of comparing data of this type involving three variables, temperature, stress, and materials, is by an analysis of variance. Such an analysis was conducted, but unfortunately several tests were run where no results were obtained for certain test conditions for the UVA Plexiglas II. For this reason, it was not convenient to include the results for the 500 lb. in^2 stress nor for the 200 ± 50 F temperature condition. All other conditions of temperature and stress were included. The analysis of variance was conducted using log values rather than the original measurements. This is an accepted procedure where the error is not of a constant order of magnitude but tends to be proportional to the magnitude of the quantity being measured. The calculations and the mathematical results of the analysis are not included in this report. The results may be summarized for both the elongation at 50 hours and the minimum creep rate as follows: For both of these properties the results of the analysis are

Table I.

Elongation at 50 Hours of UVA Plexiglas II and Plexiglas 55

Temperature		Elongation			
Mean °F	Gradient ± °F	500 lb./in.^{2} %	750 lb./in.^{2} %	1000 lb./in.^{2} %	1500 lb./in.^{2} %
		UVA PLEXIGLAS II			
160	0	0.12	0.29	0.66	0.90
	30		0.43(a)	0.68(a)	0.91(a)
180	0	0.50	0.75	0.93	1.72
	30		0.43	0.72	1.07
	40	0.30	0.61	0.80	1.26
	50	0.48	0.53	0.75	0.93
190	0	0.53	0.90	1.30	3.93
	40	0.55	1.05	1.42	2.14
200	0	1.62	6.40	8.42	11.05
	50	0.45	1.30	1.90	
		PLEXIGLAS 55			
160	0	0.10	0.27	0.32	0.64
	30	0.36(a)	0.47(a)	0.64(a)	0.86(a)
180	0	0.21	0.46	0.73	1.03
	30	0.35	0.50	0.68	1.03
	40	0.23	0.36	0.64	0.98
	50	0.08	0.30	0.42	0.81
190	0	0.23	0.49	0.75	1.55
	40	0.43	0.57	0.93	2.00
200	0	0.68	1.13	1.84	4.06
	50	0.25	0.40	0.58	0.96

(a) Estimated value; extrapolated to 50 hours when a mechanical failure occurred before completion of the test.

Table II.

Minimum Creep Rate of UVA Plexiglas II and Plexiglas 55

Temperature		Minimum creep rate			
Mean °F	Gradient ± °F	500 lb./in.^{2} %/hr.	750 lb./in.^{2} %/hr.	1000 lb./in.^{2} %/hr.	1500 lb./in.^{2} %/hr.
		UVA Plexiglas II			
160	0	0.0001	0.0007	0.0009	0.0009
	30		0.0002	0.0009	0.0012
180	0	0.0010	0.0016	0.0020	0.0046
	30		0.0009	0.0015	0.0022
	40	0.0009	0.0019	0.0023	0.0027
	50	0.0003	0.0003	0.0014	0.0012
190	0	0.0018	0.0024	0.0033	0.0139
	40	0.0015	0.0028	0.0038	0.0056
200	0	0.0054	0.0215	0.0285	0.0384
	50	0.0015	0.0026	0.0049	
		Plexiglas 55			
160	0	0.0003	0.0005	0.0006	0.0007
	30	0.0002	0.0004	0.0009	0.0012
180	0	0.0004	0.0009	0.0011	0.0015
	30	0.0006	0.0009	0.0010	0.0017
	40	0.0003	0.0005	0.0008	0.0016
	50	0.0001	0.0004	0.0005	0.0013
190	0	0.0004	0.0009	0.0011	0.0029
	40	0.0009	0.0016	0.0020	0.0064
200	0	0.0016	0.0025	0.0050	0.0131
	50	0.0004	0.0007	0.0010	0.0017

Table III.

Ratio of Elongation and Minimum Creep Rate of Plexiglas 55 to UVA Plexiglas II

Temperature		Ratio at:			
Mean °F	Gradient °F	500 lb./in.²	750 lb./in.²	1000 lb./in.²	1500 lb./in.²
		ELONGATION AT 50 HOURS			
160	0	0.83	0.93	0.47	0.71
	30		1.09	0.94	0.95
180	0	0.42	0.61	0.79	0.60
	30		1.16	0.95	0.96
	40	0.77	0.59	0.80	0.78
	50	0.16	0.56	0.56	0.87
190	0	0.43	0.54	0.58	0.39
	40	0.78	0.54	0.66	0.93
200	0	0.42	0.18	0.22	0.37
	50	0.55	0.31	0.31	
Average: 0.64					
Standard deviation: 0.26					
		MINIMUM CREEP RATE			
160	0	3.00	0.71	0.67	0.78
	30		2.00	1.00	1.00
180	0	0.40	0.56	0.55	0.33
	30		1.00	0.67	0.77
	40	0.33	0.26	0.35	0.59
	50	0.33	1.33	0.35	1.07
190	0	0.22	0.37	0.33	0.21
	40	0.60	0.57	0.53	1.04
200	0	0.30	0.12	0.18	0.34
	50	0.27	0.27	0.20	
Average: 0.64					
Standard deviation: 0.55					

similar. There is no interaction between stress and temperature or between stress and materials. There is a significant interaction between the temperature and materials, indicating that a change in temperature conditions does not affect the two materials to the same degree. Changes in stress and temperature conditions have, as would be expected, significant effects on the elongation and creep rate. There is a very significant difference between the two materials. The results are shown in figures eleven and twelve. Where the properties are plotted against the temperatures, figure 11, each point is the average of the values of the three stresses; where they are plotted against the stress, figure 12, each point is the average of the values for the nine temperature conditions. It is legitimate to draw these curves in this manner because of the lack of interaction between the stress and temperature conditions. It should be stressed that these curves have no physical meaning in the sense that values of a property may be read off a plotted scale. These curves are merely graphical statistical means of illustrating the differences between the two materials and the effects of change in stress and temperature on the materials.

A second analysis of variance was conducted utilizing some of the results at 500 lb./in.² together with

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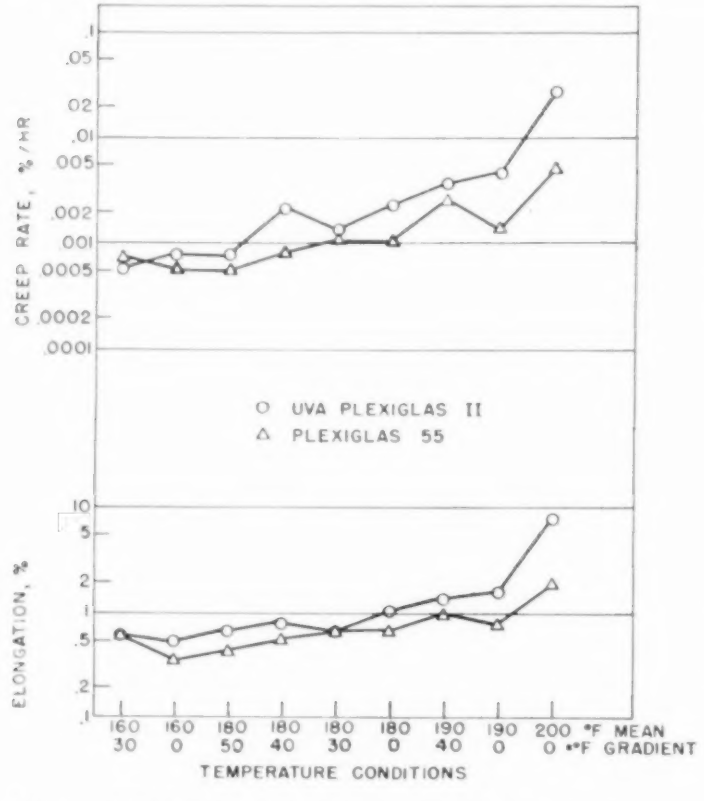

FIG. 11 ELONGATION AT 50 HOURS AND MINIMUM CREEP RATE AT VARIOUS TEMPERATURE CONDITIONS

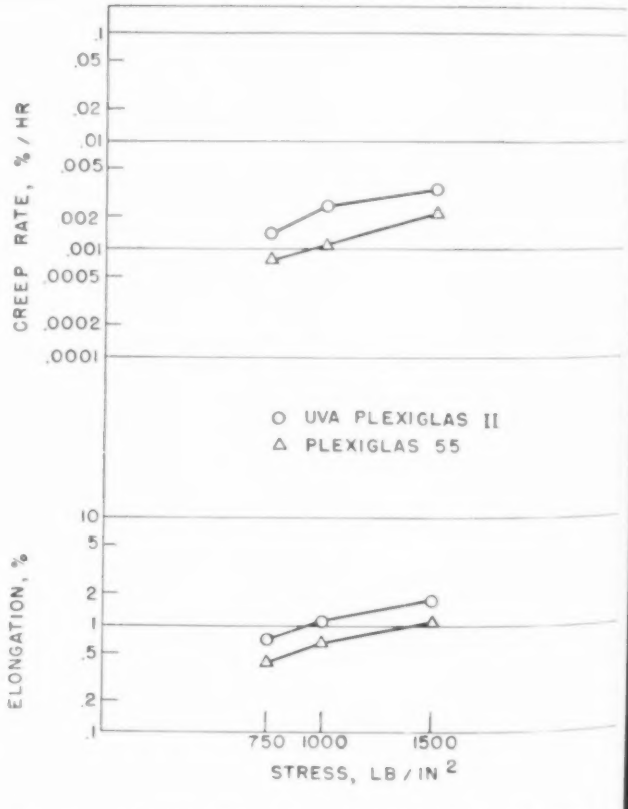

FIG. 12 ELONGATION AT 50 HOURS AND MINIMUM CREEP RATE AT VARIOUS STRESSES

bag molding

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The important process of bag molding glass fiber reinforced unsaturated polyesters is done by two general methods.

These methods and the construction of molds for bag molding are discussed in detail.

BAG MOLDING OBTAINS ITS NAME from the fact that a rigid form and a flexible membrane are used as tools in shaping plastic products. This paper will deal only with glass fiber reinforced unsaturated polyester products.

There are two general processes that may be used. In the first of these, pressures up to 30-50 psi are applied to the laminate by use of an *enclosed* membrane such as a bag or balloon. In the second, a vacuum is drawn between the rigid form and the membrane which forces the material to be laminated against the rigid form. The film or sheet of bag material is sealed around the mold periphery. The maximum pressure available by this method is about 14 psi. Variations and combinations of these processes are also in use.

In pressure molding it is necessary that the membrane be tailored to conform to the shape of the mold. The molds must be of sufficiently heavy construction to withstand the pressures used. The edges of the membrane are either sealed to a cover or brought together to make a balloon. In the latter case, a cover is required which is fastened to the edges of the mold to retain the balloon after pressurization. In either case, the membrane has been converted from a sheet of flexible material into a bag which is to be inflated. If the bag is not tailored, it is possible that a large amount of air will be trapped and the resulting laminate will be porous in some areas.

There are instances where the pressure bag process may be used with relatively low pressures. For example, with a molding having simple contours, no sharp radii or narrow fins that the bag must be positioned into, low pressures, such as 12-15 psi may be used. The more complex the design of the part becomes, the less are the chances of successfully molding the item with the pressure bag method. The difficulty is in getting the bag into the areas that are recessed from the general mold contours. A tailored pressure bag is necessary, but poor placement of the bag on the laminate is possible as it cannot be positioned correctly as the pressure is applied. In vacuum molding these difficult areas are satisfactorily molded by providing excess blanket material and positioning it as the vacuum is drawn.

The vacuum process is more popular and this paper will cover the various steps in this process. In the vacuum process the membrane need not be tailored to the shape of the mold. A sheet or film of the membrane is placed over the laminate like a blanket, leaving enough excess so that a difficult-to-reach corner will not be bridged. The membrane, or blanket, is sealed around the edge of the mold and the air between the blanket and the mold is removed. Atmospheric pressure then forces the blanket and the laminate against the mold.

The advantages of vacuum over pressure molding are:
1. The membrane need not be tailored to fit the mold.
2. The air and enough resin to result in satisfactory glass percentage will be removed through the vacuum outlets.
3. If a transparent membrane is used the removal of air, glass wet-out, and the time of cure may be easily checked.
4. The mold need not be constructed to withstand high pressures.

The ease of molding by the vacuum process results from the relatively simple operation involved. The ability to use square or rectangular sheets of blanket material eliminates the tailoring and sealing of a pressure bag. If the laminate is to be heated to speed up the cure, it can be done easily by using either an electrical heating blanket or heat lamps. Vacuum molding might appear to be less effective in achieving high glass fiber percentages due to the relatively low pressures involved. However, glass contents of 35-40% are obtained using mat, and

obtain using cloth.

Uniform resin and glass contents are obtained, even in areas where the glass fabric is overlapped, as the atmospheric pressure on the flexible blanket, and laminate, is equal at all points.

The difference in mold construction between vacuum and pressure may appear to be of little importance, especially if the part is to be molded at 12-15 psi. Further analysis will show the vacuum process to have a considerable advantage. The simplest example possible is to mold a flat sheet. With pressure in an enclosed bag the cover and the table which the laminate is to be cured on must be built strong enough to withstand the pressures used. Over a large area this will require a heavily reinforced laminating table and bag cover.

The vacuum process does not require these reinforced tables and covers. This is because atmospheric air pressure downward on the top of the flexible blanket and up on the bottom of the mold are equal and hence there is no force on the mold. The mold need be only strong enough to maintain its contours and any abuse it might receive in the laminating process. To make a flat laminated sheet, the mold may be a glass plate. The laminate may even be made between two sheets of flexible membrane sealed around the edges.

THE MOLDS AND AUXILIARY EQUIPMENT

Molds

Molds for the vacuum molding process may be made from any material that is either nonporous or that can be given a nonporous surface. Among the materials that may be used are metal, plaster, wood and plastics. Molds made from sprayed metal, plaster, or plastic materials will require the preparation of a master mold. The master mold is a duplicate of the form desired in the part to be made. Not only the contours but also the surface texture of the master mold will be reproduced on the final part. The master mold may be made using wax, wood, plaster or plastic materials. With all of these, the master mold should be sanded and polished to the same surface texture desired on the final molded part.

The choice of materials for production molds will depend on the number of parts to be made. Metal molds can be given a very good finish and are very durable. They may be made of sprayed metal, sheet metal, or by using other processes. Disadvantages of metal molds include their cost and weight. For example, a sprayed metal mold would require the preparation of a master mold, spraying it with metal, removing and mounting the sprayed mold for use.[1]

Plaster and wood molds may be used if they are correctly prepared. They are not recommended for vacuum molding due to their porosity. It is necessary to seal the mold surface to prevent air in the mold material from entering the laminate when the vacuum is drawn. Plaster and wood molds are not durable and, although they are the least expensive, can be used for only a few moldings before repairs are necessary. Even with repairs the mold may not be suitable for use after 20 to 30 parts have been made. A phenol-formaldehyde product, known as "Rezolin"[2], has been used to make plastic molds. This material is cast, rather than laminated, on the master mold. Thick mold sections and strong supporting frames are required to strengthen the mold and to retain the desired mold dimensions.

Polyester or epoxy laminated molds are also made from a master mold, and subsequent operations proceed faster, with a lower material cost and lower weight when mounted. The high strength and rigidity of laminated glass fiber plastic molds makes possible the use of much thinner sections. Besides the advantage of light weight, polyester and epoxy molds are durable, have good dimensional stability, and a good surface texture is obtained easily. They will not lose their physical properties if moderate temperatures are used in the production operations.

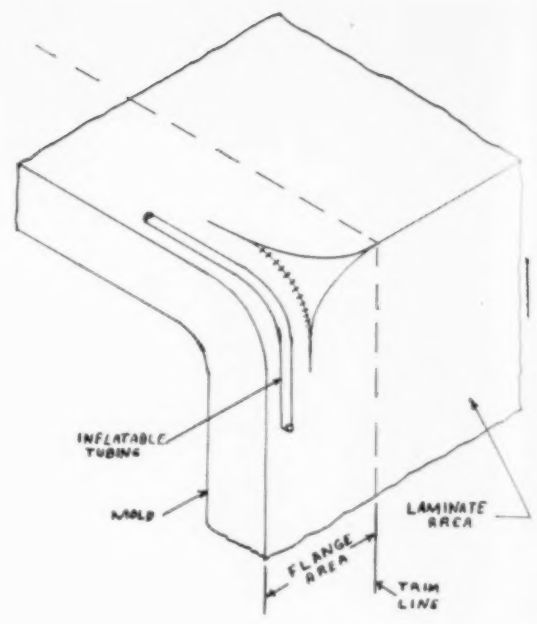

Fig. 1. Flange Area

Polyester molds are made by spraying the master mold with a suitable mold release followed by a sprayed gel coat which is allowed to cure sufficiently so that the fiber pattern of the reinforcing material is not apparent on the surface of the mold. Thereafter, each ply of tailored mat or cloth is placed on the master mold and is saturated with resin. Additional plies are added until the desired thickness is obtained. The number of plies and the thickness of the mold is determined from its shape. Generally it should be $\frac{1}{4}$-$\frac{3}{8}$ inches thick. Large molds without strengthening contours may require the incorporation of reinforcing members or the use of thicker sections.

Either a male or female mold may be used with the vacuum process. The choice will depend on several factors which are: the side of the finished article requiring the smoothest surface, presence of undercuts, ease of molding and removal from the mold and the complexity of the part. Usually it is the outside surface of the product on which the smoother surface is desired. This means that the part should be made in a female mold. The blanket then acts as the male mold. This system is used in most vacuum processes. The rest of this report covers only the use of female production molds. If a smooth finish is desired on both surfaces, a light weight laminate made with reinforced polyester resin may be used as a matching male mold. This male mold is placed next to the wet laminate with the blanket on the outside of the whole assembly.

In addition to having a smooth surface and being dimensionally exact, the female mold must be designed to fit the rest of the operations. The mold should be supported on three legs. If a frame is built with more than three legs, the frame and mold will distort if placed on an uneven floor. When size or shape of the mold re-

quires more support for working stability, the first parts should be checked carefully for the required dimensions.

Flange Area

The flange area, or the area between the trim line and the edge of the mold is nearly as important as the mold contours. This distance should be 5 to 6 inches. The trim line is a line scribed into the mold that will show on the laminate and indicates where the excess or flash material is to be removed. Generally, the contours of the mold should be continued for one inch beyond the trim line. This is to insure that the mat or cloth will not bunch, twist, or taper out near the trim line. Past this area the mold should be as flat as possible. Sharp angles in the flange area should be rounded to a minimum radius of 2 inches. (Fig. 1)

Bleeder Ring and Vacuum Outlets

The purpose of a bleeder ring is to provide a pathway for air and excess resin to the vacuum outlets. The recommended bleeder ring material is $\frac{1}{2}$" electrical conduit which has been split in half. The split conduit is cut, welded and formed to the shape of the flange area. It should be at least two and preferably $2\frac{1}{2}$ to 3 inches outside the trim line at all points. A small notch every 5 to 6 inches, made by cutting or grinding the inside edge of the bleeder ring, will serve as a pathway for air and any excess resin in the laminate to escape. Vacuum outlets are drilled through the mold underneath the bleeder ring. Traps, such as Mason jars, containing a small amount of water are placed directly beneath the vacuum outlets. The excess resin will drop into the jar. Another opening in the top of the jar leads to the vacuum pump. The number of outlets required per mold will depend primarily on the shape of the part. A square or rectangular mold will require about one outlet for every 2 feet of perimeter. If the mold is long and narrow, for example 2 feet by 6 inches, a vacuum outlet on each end is sufficient. In this case the outlets should not be placed in the center of the length of the mold across from each other as a large amount of resin might be removed in this area leaving the two ends porous. On parts with a small perimeter compared to the mold area, such as a hemisphere, it may be necessary to bleed the air from the center of the part. Strips of mat three or four inches wide having poor wet-out properties ($\frac{3}{4}$ oz. low solubility treatment mat) placed from the center of the part almost to the bleeder ring will provide a pathway for the air to escape. The strips are placed on the wet laminate. Voids in the strip will fill with resin as the air is removed.

Clamping Frames

Two to three inches should be allowed from the bleeder ring to the edge of the mold for the clamping frame. This frame presses the blanket against the mold and forms an air tight seal. The frames should follow the contours of the flange area of the mold. To the frame may be attached either a soft rubber gasket, such as sponge rubber, or an inflatable tubing. The rubber gasket may be attached by taping or any other convenient method. The frame and rubber gasket are pressed against the mold by using C clamps. If the inflatable tubing is used a hinged L-shaped clamp may be attached to the frame. After the frame and clamps are in position the tubing is inflated to about 20 psi which forces the blanket against the female mold. Vinyl or other plastic tubing is satisfactory for this use. A strong and light weight square or rectangular cross sectioned frame may be made from 16 gage (.065 inches thick) sheet metal. A wood frame made from 4 x 4's is satisfactory, if the flange area is horizontal.

Membrane Materials

PVA (polyvinyl alcohol) film is a satisfactory blanket material. This material is strong, slightly elastic and does not inhibit the cure of polyester resins. It is easily sealed if the mold is wider than the width of one sheet. It is soluble in water and a solution can easily be made. Using a brush or rag, this solution is spread along the edges to be bonded. The edges are brought together and the bond completed by heating slightly with an iron. A small amount of paste wax will prevent the warm iron from sticking to the PVA. The disadvantage of PVA is that it cannot be used repeatedly. Usually only one and at most two or three parts can be made with a sheet of this blanket material.

Vinyl and polyethylene sheets may be used for several moldings, but they inhibit the cure of the resin leaving a tacky surface on the blanket side. It is preferable to use a matching male mold so that it extends over the bleeder ring. This protects the vinyl or polyethylene blanket material from the resin and it may be used for several moldings under these circumstances. To seal the vinyl and polyethylene sheets heat and pressure are necessary. Cellophane is not recommended due to its poor tensile strength, brittleness and difficulty in bonding two pieces together.

Heating The Molds

Heating has the advantage of shortening the cycle time, or the time interval between which successive laminates are removed from the mold. Depending upon the cure time at room temperature, the number of parts molded in a day may be doubled or tripled with heat. The heat should be applied through the blanket, and if used, the matching male mold. Heating through the female mold may weaken it and result in distortion. The method used to apply heat to the laminate should be based on its effectiveness, ease of operation and cost. Electric heating blankets are satisfactory except for the initial cost, especially if the electric blanket needs to be tailored to conform to mold contours. Heating blankets are easy to handle and produce an even heat. Chromalox radiant heaters give uniform and easily controlled temperatures. These units are efficient but have a high initial cost and must be put in a frame. Heat lamps are not satisfactory, because they concentrate the heat in a small area. Electric light bulbs, in a partially enclosed box, placed over the mold will effectively heat the laminate. Light bulbs have a low initial cost, but the operating cost is relatively high. The inverted box containing the light bulbs may approximate the mold contours which will result in a fairly uniform distribution of heat. One 100 watt light bulb for every square foot will increase the temperature of the laminate about 60°F. The light bulbs should be 6-8 inches from the laminate.

Methods of Saturation

In making a laminate the saturation process will vary depending on the form of the glass and whether male molds are used. Glass cloth may be saturated easily on the female mold without using male molds. The cloth is placed in the mold and the catalyzed resin brushed or painted on after each layer. With a relatively flat mold all the glass may be positioned on the mold and the resin poured over it because washing is not a problem when fabric is used. After the blanket is in place and the vacuum drawn, rolling may be necessary to eliminate any resin richness in the laminate. A short length of rubber tubing, such as is used in vacuum lines, or a part of a washing machine wringer roll may be used for rolling the laminate. A resin to cloth weight ratio of 1 to 1

should be used which will give a laminate of 50-55% content.

Three general procedures for saturating glass fiber mat are:

1. Dry lay-up on the female mold, resin brushed on, male mold required.
2. Dry lay-up on the female mold, resin sprayed, male mold not required unless smooth surfaces on the blanket side are desired.
3. Mat saturated by resin pick-up from a table and placed in the female mold wet, male molds not required unless smooth surfaces are desired on the blanket side.

Regardless of the process used, the mat as it is placed in the mold, should be trimmed and tailored to eliminate overlays and bunching of the mat in curved areas. This is especially true when matching male molds are used as high glass and adjacent high resin areas will otherwise result. It is also desirable to apply as much resin as possible to the first ply of mat in the mold. The last ply of mat placed in the mold should be left dry. As the vacuum is applied, the air in the last ply is removed by the resin moving toward the blanket or male mold. The result is a dense laminate containing very little air. With mat about 35-40% glass content may be obtained.

In the first procedure the resin is brushed on the mat as each ply is placed in the mold. Male molds are used to distribute resin rich areas that result from the brushing. The male mold is placed next to the laminate. The blanket is the last to be positioned. It is possible to brush resin on the mat when male molds are not used, if care is taken. However, it is possible that the laminate will have dry and resin rich areas. An excess of resin will not move through the mat to the dry areas, without rolling, when male molds are not used, because regardless of the uneven thickness of the part, all points are under the same pressure.

With the second procedure the resin is sprayed after each ply of mat is in position on the female mold. The resin can be applied evenly and male molds are not required. The blanket is placed next to the laminate. The wet-out of the mat and the cure of the resin are easily checked. Spraying should not be attempted unless an exhaust fan is provided to remove the monomer vapors.

In the last procedure the resin is applied to the mat by using a saturating table or similar device. The table should have a smooth surface, such as glass, which can be cleaned readily. Resin is poured onto the table and an even film made on it by using a doctor blade. The blade is flat edged with adjustable spacers on each end which ride on the glass table. The mat is then pressed into the resin film by a heavy roller. After it is saturated the mat is placed in the mold. There are several disadvantages in this type of saturating procedure, and it should be avoided whenever possible. The disadvantages are: 1) Some glass fibers are left behind in the resin on the table, soon making it very viscous and difficult to spread in an even, thin film for the next ply of glass; 2) The resin must be catalyzed for a slow cure to allow for cleaning the saturation apparatus; 3) The mat stretches and is not easily placed in the mold when wet. As a result, it often requires tailoring after it is in the mold. Another problem arises, if resins of different viscosities are used. The thickness of the resin film will be greater with a low viscosity resin, if the spacers on the scraping blade are not changed. This is due to the tendency of a high viscosity resin to move with the blade, in effect, stretching the resin across the table. A film thickness of .05 to .07 inches will yield 34-40% glass when 2 oz. mat is used. If less resin is used, considerable rolling may be required to wet out the mat.

The thickness of the laminate will depend on the vacuum source and the form and number of plies of glass used. Three plies of 2 oz. mat will result in a laminate .10 inches thick with 40% glass, if the vacuum is good. If all cloth is to be used six layers of HG 64, or similar fabric, will be necessary to obtain the .10 inches of thickness. This will vary depending on the type of glass cloth used.

Plastic Matching Male Molds

Glass fiber reinforced male molds made with polyester resins may be used to an advantage when molding with glass fiber mats. They aid the saturating technique and they are necessary where the blanket side needs to be smooth. The male molds are placed directly on the laminate. The blanket is positioned last. When the vacuum is drawn, atmospheric pressure forces the blanket, male mold, and laminate against the female mold. If cloth, instead of mat, is to be used, male molds are of little value. The cloth saturates easily without the aid given by the male mold and the side next to the blanket is reasonably smooth.

In making a male mold the first step is to position guide pins in the flange area of the female mold. (Fig. 3) These pins will align the two molds correctly. The pins should be about $\frac{3}{4}$ of an inch above the female mold, and about $\frac{1}{2}$ inch in diameter. A layer of molders sheet wax the thickness of the part to be molded, is then placed on the female mold. The bleeder ring should be correctly positioned and the sheet wax placed to cover all the inside area of the mold within the bleeder ring. On symetrical molds the wax lay-up is best started down the center line. As an aid in forming the wax around curves and over corners, it may be softened by placing it in hot water for a few moments. Cutting knives and scrapping or smoothing blades or bars can be warmed in an alcohol flame or by heating under a heat lamp. Scratches on the wax surface may be readily smoothed by rubbing with a cloth wet with a solvent such as lacquer thinner. Following the wax lay-up the wax, bleeder ring and flange area should be sprayed with mold release. After this has dried a resin coat is sprayed over it and allowed to cure. Glass cloth and mat are positioned and a polyester resin is applied in the manner used in making the female mold. The lay-up is continued over the bleeder ring and for about $\frac{1}{2}$ inch is flush with the female mold surface. The male mold made in this way will position the bleeder ring and also determine the part thickness during the production molding. Heat should not be applied until the resin is past the gel stage, due to the relatively low softening point of wax. In making the male mold, vacuum cannot be drawn as it would remove the resin from the laminate. The male mold does not need to be exceptionally strong. A mold $\frac{1}{4}$ of an inch thick is satisfactory. The male mold should be given the same treatment as the female mold to insure good release from the laminate. It should be smooth, non-porous, and coated with a mold release agent.

If the female mold is in the shape of a U with high vertical sides, the male mold may need to be cut down the center so that one part is put in at a time. A strip of cellophane placed beneath the center line cut will prevent the resin from seeping to the bag side of the male mold. If the depth of the U is less than two inches, rather than cutting the male mold, a good part may be molded by laying the mat up on the male mold and then putting both into the female mold at the same time.

Vacuum Molding

From a bag molding viewpoint a few special properties of the resin are desirable. The viscosity of the resin cannot be too high or too low. A viscosity range of 400 cps to 1000 cps is satisfactory. Very low viscosity resins are difficult to use due to run off through the mat before the vacuum can be applied. Very high viscosity resins are objectionable due to their resistance to flow. This is particularly true when using mat, but also applies to cloth laminates. The high viscosity resins do not flow readily to wet out dry spots and if forced to move may wash the mat.

The resin should have the desirable property of passing quickly from initial gelation to a cure stage wherein it is sufficiently strong to remove the part from the mold. This allows a fast cycle of operation, especially if a small amount of heat can be applied to the mold. Another desirable property is to have the same gel time on the mold (at room temperature) as is obtained with a large mass of resin. This is necessary so that enough time is available to clean the equipment before the resin gels. The use of fillers in bag molding is not necessary and has no advantage other than to lower the cost of the product. A filler having thixotropic properties is disadvantageous due to poor flow properties and slow wet-out of the glass.

Molding The Laminate

The steps in the molding process are:

1. Cleaning and preparing the mold
2. Molding the laminate
3. Removing the part from the mold

Usually all that is required in cleaning and preparing the mold is to remove any dust particles and coat it with a mold release such as a solution of polyvinyl alcohol in water. If the previous part had been removed before the cure was complete and some uncured resin remained on the mold, this resin may be removed easily by using a solution of soap and water. Acetone and other solvents should be avoided. The solvents, if used frequently, may soften the plastic molds and also leave a film on the mold surface that should be removed with a soap solution, if a high gloss is desired. Whenever the soap solution is used the mold should be waxed and polished before applying the mold release. Depending on the gloss of the mold surface, after about 10 normal moldings, the mold should be waxed and polished before the mold release is re-applied. If there is a tendency for the laminate to stick to the mold, the wax should be used more often. Any good paste wax may be used for this purpose. The male molds and bleeder ring should also be waxed and then sprayed with the mold release. No sticking will be encountered from molds having a high gloss and a nonporous surface. With molds having a good surface the waxing operation is not necessary.

Taking as an example the process of brushing the resin on the mat, the molding of a laminate .10 inches thick is accomplished in the following manner. The mold is cleaned. The mold release is applied and allowed to dry. The gel coat, if used, is applied and allowed to cure. The first layer of mat is placed in the mold. With a pair of scissors the mat is tailored removing excess material and cutting out any overlapping or bunching of the mat. Butt joints are satisfactory if three or more layers of mat are used. The resin is catalyzed and applied by brush to the mat. The second layer of mat is placed in the mold and tailored. Any remaining resin is brushed on the mat. The resin is applied as evenly as possible. A third layer of mat is placed in the mold and tailored. The bleeder is placed over the vacuum outlets. The male mold is positioned on the guide pins. The PVA, polyvinyl chloride,

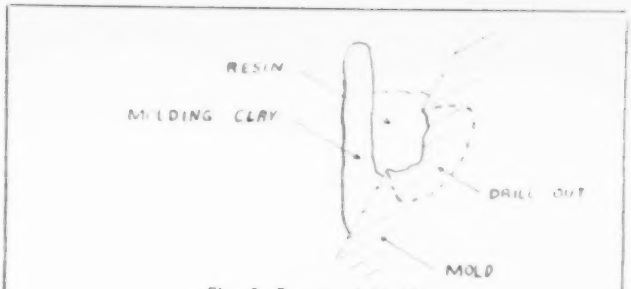

Fig. 2. Repair of Mold

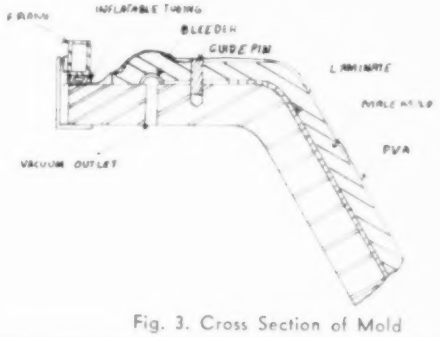

Fig. 3. Cross Section of Mold

or polyethylene sheet is placed over the molds leaving enough excess sheet in the corners so that it will not bridge. The frame to press the membrane against the female mold is positioned and clamped. The vacuum is drawn. It is advisable to draw the vacuum slowly so that the bag may be checked for bridging. Once full vacuum is obtained it takes only a few minutes for the mat to wet out completely. When the thumb nail can be pressed into the part without leaving a white mark the laminate is ready to be removed from the mold. The vacuum is released and the clamping frame removed. A jet of air is usually all that is required to remove the laminate from the mold. If the mold release was not correctly applied and the laminate sticks, steel or brass bars should not be used as wedges between the laminate and the molds, because the molds are made from relatively soft materials. Thin plastic strips, left over from a trimming operation, will not damage the molds.

If a small area of the mold breaks away on removing the laminate, the mold may be easily repaired by first drilling out the damaged area so that it is undercut and then filling it in with the same material with which the mold was made. (Fig. 2) If the damaged area is on a curve the liquid plastic may be dammed in by using molding clay. The patched area, when cured, is sanded to the contour of the mold. Number 320 emery paper is satisfactory for this operation.

Trimming The Laminate

Trimming the laminate is best done with the aid of jigs. If several parts can be trimmed one after the other without changing the saw settings, the trimming operations become fairly routine. A circular saw having a blade easily positioned at any angle in any plane is very useful. An abrasive wheel is used in cutting. Band saws, belt and disk sanders, and wood rasps and other such course filing tools may be helpful depending on the finishing operations that are necessary.

REFERENCES

1. *W. Brenner* and *L. Hase*, Modern Plastics, *30*, No. 1, 105 (1952).
2. *Rezolin, Inc.*, Los Angeles, California.

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

"It is the freedom to disagree, to quarrel with authority, in intellectual matters to think otherwise, that has made this nation what it is today." Dr. James B. Conant

I have been keeping rough tabs on convention and meeting attendance. The percentage of molders and other processors present has been dwindling. This is a serious trend. It is by, for and of the molder that we exist. I do not know what has caused some molders to drift away from our meetings. What can we do to stem this tide? We should have more meetings where the molders tell us what they want, and fewer meetings where we tell the molders what we have for sale, and what we can do for them. The powerful sales pitches, to which the loyal processors attending meetings are subjected, has finally had the sad result of shutting off our one best source of new ideas—the molder.

We peddlers and salesmen who live off of the molder, should remember that our societies exist for the molder. We should shut up long enough to give the molder a chance to tell us about his problems. We MUST have more meetings where molders, processors, users, and buyers of plastic are heard from, where they are enabled to tell us what we can do for them. Jerry Formo, as chairman of the National Speaker's Committee, wrote several hundred letters to molders asking what they wanted discussed at our 1955 SPE Technical Conference in Atlantic City, and got ALMOST NO REPLIES. Our biggest job is to urge more molders to attend more meetings—to urge them to be more articulate.

The SPI is already taking vigorous action to put the molder back in the driver's seat. Will the SPE, without the benefit of unlimited finances and a huge professional staff, be able to follow suit? This may be our supreme test—our greatest challenge. Let's make it our business to have molder and processor attendance set an all time high at our 1955 Atlantic City Conference, and at all our 1955 Section Meetings. Let's not drive only for more members in 1955; let's put on a real campaign to get molders and processors to come **back** to our meetings.

Let's make it still more worth the molder's while to belong to SPE with better programs, fewer sales talks, more talks by molders, and better recognition of the suppliers subordinate position. Let's make 1955 the molder's year!

Editor's Note: It is indeed true that the SPE is the molder's society—the society of plastics **engineers.** And we think Ren Morse will be as pleased as anyone to read our program for the Eleventh SPE Conference, printed in this issue. The molder has indeed been kept in mind, and this program will give the molder new information not only on materials, but on processes and methods of molding. Check our program and see!

"About once a year, the editor of your SPE Journal lets me slip through a few pregnant paragraphs of a general nature. This is my blast for 1955.

Eastern New England

Be-Cu Mold Parts

Walter W. Peacock, Jr.

A combined meeting of the SPE Eastern New England Section and the SPI Boston-Providence Chapter was held at the Hotel Beaconsfield, Brookline, Massachusetts on Thursday, October 21, with a total attendance of 67. The Cocktail Hour took place at 6:00 P.M. and the dinner meeting at 6:30 P.M.

Mr. Joseph P. Healey, Vice President in Charge of Sales of Manco Products, Incorporated, spoke on "An Evaluation of Beryllium Copper for Mold Components in Injection Molding."

Mr. Ralph Mondano talked on "Plastics Education" and at Mr. Mondano's suggestion the possibility of a series of lectures is under consideration.

A plastic wading pool was won by Richard Bishop of Foster-Grant Company.

Buffalo

Hetron Resins Are Unique

R. W. Miller

The Buffalo Section of the SPE held their regular monthly meeting October 15th at the Park Lane Restaurant. Members and guests were enlightened by Dr. T. C. Dauphine, Manager of Sales Development, Hooker Electrochemical Company, who spoke on Hooker "Hetron" resins.

"Hetron" resins are unique polyester resins which possess outstanding fire and heat resistance combined with excellent strength and electrical properties. They were introduced by the Hooker Electrochemical Company in 1953. These resins are different from other polyesters in that Het acid, a stable chlorine containing dibasic acid is incorporated into the molecular structure of polyesters. Het acid is formed by hexachloropentadiene and maleic anhydride.

This exceedingly heavy molecule (MW 389) reacts smoothly with the usual glycols and with maleic or fumaric acid to form an integral part of the polyester chain. The chain may then be cross linked through styrene or other cross linking agents. The double bond in the ring is unreactive.

Het acid is stable to heat and hydrolysis. The acid contains about 55% chlorine by weight and resins may contain over 50% by weight of Het acid. This results in a polyester containing as much as 30% chlorine.

These resins cure tack free in contact with air. The more flexible resins show some tack. These resins show good resistance to acids, bases and water over a wide temperature range. They are not recommended for use against oxidizing acids, alkalies, some chlorinated solvents, and oxygenated organic solvents like acetone or ethyl acetate. Modifications to induce flexibility generally reduce chemical resistance. These resins may be cross-linked with the usual cross-linking agents such as styrene, vinyl toluene, triallyl cyanurate or diallyl phthalate. These resins are conventional in their curing characteristics. No difficulty is encountered either with room temperature cures or very short mold cycles. They are characterized by very low loss factors over a wide range of frequencies. "Hetron" resins are extremely fire resistant at no sacrifice in other properties.

Additional information on "Hetron" resins and their properties can be found in the following references:

Preprints — Ninth Annual Technical and Management Conference, Reinforced Plastic Division, Society of the Plastics Industry, Inc. Feb. 4, 5, 1954. Section 7E. Industrial and Engineering Chemistry August 1954, page 1628.

AROUND THE WORLD

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AUSTRALIA

AUSTRALIAN PLASTICS

Vol. 10, No. 103, February 1954

Abstracter: **Albert Lightbody**

RECENT DEVELOPMENTS IN P.V.C. (p 6-12) D. G. Owen

The various factors such as molecular weight, viscosity, copolymerization, plasticizer, particular size and condition are discussed as they affect the use of P.V.C. as extrusion and molding material. Data are given concerning the consumption of P.V.C. in various applications.

MODIFIED POLYSTYRENE (p 13-16) D. R. Crabtree

The eight grades of "Erinoid" polystyrene are listed with their properties and typical uses. The advantages of the modified grades of polystyrene in freedom from stresses, easier molding and superior heat and impact resistance are emphasized.

I.C.I. PUBLICATION "THE PLASTICS SPHERE" REPRINTS

The extensive use of polyethylene in the playroom is pointed out. Nylon combs give advantages in long wear and general adaptability, although higher in price than polystyrene combs. Polyethylene coated paper is being used in packaging many things from fertilizer to food. An interesting material is the transparent lamination of cellophane and polyethylene, giving the better printing surface, odor proofness and dimensional stability of the cellophane while retaining the toughness and water resistance of the polyethylene.

Vol. 10, No. 104, March 1954

PROGRESS OF AUSTRALIAN LAMINATES INDUSTRY (p 16)

"Lamilex," a decorative plastics board, is now being made in large quantities. It is being exported from Australia, selling competitively against local produce, especially in England.

POLYETHYLENE INSULATED CABLE LINKS EUROPE WITH SOUTH AMERICA (p 20-21)

Pictures and story depict the laying of more than 1750 miles of polyethylene coated cable between Recife, Brazil and the Cape Verde Islands. Savings in materials, weight and costs with improved performance have been the result.

CHEMISTRY-FOUNDATION OF THE PLASTICS INDUSTRY (p 24-25) J. P. Baxter

Condensation of a lecture giving a survey of the processes required for the manufacture of the most important types of plastics materials.

HIGH FREQUENCY HEATING (p 46-18)

A very complete discussion of the uses to which high frequency heating is being put. This includes the preheating of plastics preforms before molding with the increased production rate and improved quality to adhesive bonding. Advantages and disadvantages are listed with illustrations of the principal uses.

Vol. 10, No. 105, April 1954

HOT GAS WELDING EQUIPMENT FOR PLASTICS

Both the gas heated and electric heated equipment for the hot gas welding of polyethylene and polyvinylchloride is described in detail. The method of application and the properties of the materials are also covered. The author goes into considerable detail in all phases of welding as well as the effect of the heat upon plastics materials.

VACUUM HEAT DRAWING AND FORMING MACHINE, "FORMVAC"

This is a description of the equipment and the methods used in the forming machine which has been produced by the plastics development division of Hydro-Chemie Limited in Switzerland. This equipment uses radiant heat for softening the sheet and vacuum is used to pull the material down into the die, which can be made from such materials as wood, plaster, cement, cast resin or light alloys. The use of offset lithography for printing is widely used to get decorative effects.

THE KREIDL PROCESS

The Kreidl process, which is covered by U. S. Patent 2632921, is described as a heat treatment on the surface of polyethlylene which makes it receptive to printing inks and adhesives without changing the chemical or strength properties of the material.

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GERMANY

KUNSTSTOFFE

Vol. 44, No. 9, September 1954

Abstracter: **Anne Schwend**

ACCEPTANCE TESTS IN THE PLASTICS INDUSTRY by Herbert Mertz

Since the plastics industry is more and more forced to lay down and adopt acceptance tests for both the supplier and the fabricator, some methods are discussed part of which was developed in the U. S. during the war, to solve this problem. On the basis of shrinkage tests of rolled-up PVC films these methods are further explained and mathematical tables set up for easier determination of the acceptability of the batch of material investigated.

MOLDED PARTS FROM WOOD CHIPS by E. J. Ritter

Following a survey in the August Abstracts on the production of molding compounds from wood chips, this article releases information on experience gained in the molding technique of this material of low flow characteristics. The smaller the wood chips used, the greater the resin content and, hence, the better the flow characteristics and formability. Sawdust, in particular, with a resin content of up to 40% represents a very fine molding compound of excellent properties. Design details that should be observed are: simple overall design, uniform wall thickness, gradual transitions, avoiding of beads, beaks and abrupt bosses. Design of compression molds, heating and cooling devices for upper and lower mold halves as well as hydraulic presses used for mold-

ing are discussed. To augment the output, multiple platen presses for alternate charging and molding are employed.

A table showing a number of exemplary shapes of moldings explains technological data and requirements, general properties of material, kind and percentage of resin binder used as well as the necessary specific molding pressure.

Steady development and improvement of molding compounds from wood chips and sawdust will certainly help to introduce this molding technique on a larger scale.

DETERMINATION OF THE SYNTHETIC RESIN BINDER CONTENT IN FLOORING COMPOUNDS ON POLYVINYL ACETATE BASIS by Eva Gollmer

The method described is based on the splitting up of high polymer polyvinyl acetate into its components, their dissolution and weighing of the remaining filler content. The difference between the original weight of the compound and that of the filler after decomposition represents the resin binder content. Decomposition is effected by complete saponification of polyvinyl acetate with methyl alcoholic potash lye after preliminary dissolving in methyl alcohol and dissolution of the resulting polyvinyl alcohol in water.

This method is also applicable in case flooring compounds should be introduced in Germany as they are now used in the United States on the basis of dispersions of copolymers of PVC with polyvinyl acetate by simply changing from ethyl alcohol to tetrahydrofurane for the preliminary extraction.

FUNCTION AND TECHNOLOGY OF PRESSURE SENSITIVE ADHESIVES by D. H. Sonne

Prompted by the steadily increasing demand for non-drying adhesives, a survey on their chemical nature, their production and application is given. Based on the function of pressure-sensitive adhesives such as the choice of proper base materials, the addition of various resins, fillers, plasticizers and solvents and the results obtained are discussed. The kind of backing material receives particular mention.

TECHNOLOGICAL PROBLEMS UPON HOBBING OF PLASTICS CAVITIES IN STEEL by G. Folke

A discussion of the plastic deformation of steel, its flow properties, flow phenomena upon hobbing of cold steel blanks, the limits of formability of steel, distribution of stresses in the steel blank upon sinking the hob into the blank, calculation of hobbing pressure and comparative data on hobability of various kinds of steel, deformation of steel blanks held by hobbing rings during the process and free hobbing of blanks, lubrication of master hobs by metallic copper deposits and of other questions is followed by a description of commonly used kinds of steel in Sweden for the hobbing of cavities for compression and injection molds and the cutting of master hobs.

GERMAN STANDARDS

Draft of DIN 16930 "Welding of Rigid PVC" is published for discussion. Its purpose is to lay down the characteristics of various kinds of welding as a basis for orders, execution and acceptance. Welding methods are described including equipment used, welding stock needed, differentiation between weld seams, preparation of parts, additional treatment and quality of weld line.

DESIGN OF INJECTION MOLDS by Hans Gastrow

Design details of molds for parts with molded-in metal inserts and for long tube-like parts.

THE U.S. RETAILER LOOKS AT PLASTICS

Excerpt from SPE Journal, October 1953 issue.

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PLASTE UND KAUTSCHUK

May 1954

Abstracter: Walter Brenner

THE CORRECT APPLICATION OF PLASTICS IN THE PRODUCTION OF MOLDINGS

The paper describes the properties of representative plastics and basic principles involved in the production of moldings from these materials.

PLASTICS IN AERONAUTICS

The properties and application of plastics in the aircraft industry are described with special emphasis on reinforced polyester and phenolic resins. The contrast between presently attainable properties and those required is emphasized, especially with regard to rocket bodies and similar applications. The advantages of phenolic resins over competitive materials for high temperature applications are given full consideration. The future of reinforced plastic materials as primary structures is held to be bright.

INCREASED PRODUCTION APPLICATIONS OF PLASTICS

New applications of plastic materials are described. Special attention is given to hard vinyls in industrial applications and polystyrene copolymers for household applications.

ELEVENTH ANNUAL
CONFERENCE
Atlantic City **Jan., 1954**

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GREAT BRITAIN

BRITISH PLASTICS

Vol. 27, No. 9, September 1954

Abstracter: E. A. J. Mal

POLYTHENE PAPER-COATING PLANT. pp 345-347

The two automatic paper unwinding gears, the rollers and the automatic winding gears should be well known to the American reader as the equipment has been built in England under license from F. W. Egan and Co., N. J. The extruder is an 8" F. Shaw machine and has an output of 700-800 lbs h. It is powered by a 75 HP motor and operated at screw speeds of between 8 and 82 rpm. The machine is heated by four 15 kW and four 30 kW heaters. The dies are 55 and 72" long, film thickness is 2-20 mils. Paper speeds are 120-[illegible] feet min, single and double laminates can be made.

INJECTION MOLDING OF POLYAMIDES. L. Griffiths and M. G. Munns. pp 352-355

For the 66-Nylon (I.C.I. designation Nylon AF) mostly used for injection molding, a high rate of injection is desirable together with a very accurate temperature control. The molding range is small (264-285 C) being limited on the lower side by the melting point and on the higher side by the discoloration temperature.

A special nozzle design is necessary to prevent "dribbling." The idea is to prevent flow during the mold-open period through local freezing within a restriction in the nozzle, i.e. due to the combination of material viscosity and orifice resistance. The system demands an extension nozzle containing a sealing restriction positioned some distance (approximately [illegible]) from the front face and heated and controlled independently from the cylinder heaters. A flat faced nozzle is more dependable than a radiused one, the optimum orifice has a length of 1 16-1 8" and a diameter of 0.0[illegible] for a $\frac{1}{2}$-6 oz. mold.

USE OF ACRYL'C SHEET FOR DEFORMABLE WIND-TUNNEL MODELS. J. Black. pp 356-359

Conventional wind-tunnel models are usually cut from solid blocks of laminated mahogany to steel bolt plates and highly polished. In actual flight slight deformations of the wings of an aircraft occur and these may have an important influence on the aerodynamic characteristics. To simulate those small deformations in the standard rigid models is very time consuming and costly, a deformable model obviously has great possibilities.

(Please turn to page [illegible])

SECTION NEWS

Edited by

Stanley Bindman

Jamison Plastic Corp.
1255 Newbridge Road
North Bellmore, L. I., N. Y.

Milwaukee Section

Film Illustrates Greater Possibilities In Aviation

Marvin C. Stowe

The October 12, 1954 meeting of the Society of Plastic Engineers was held at the Joe Deutsch Cafe where the members and guests enjoyed a delicious sirloin of beef dinner. After the dinner the Section had it's monthly business meeting. Following the business meeting Mr. George Stein, the President, introduced the main speaker of the evening Mr. Wallace E. Wirsch. Mr. Wirsch was representing the Rohm and Haas Company from Philadelphia, Pennsylvania.

Mr. Wirsch first showed the Section a sound, color movie, entitled "Future Unlimited". The movie illustrated the use of jigs and fixtures, manufacturing techniques and a couple of applications for Polyester Resins. The movie was co-sponsored by Rohm & Haas Company, Philadelphia, Pennsylvania, Libbey-Owens-Ford Glass Company, Toledo, Ohio and the Zenith Plastics of California. The movie showed the part each company played in the production of fiberglass reinforced plastics. It was brought out in the movie what part plastics are playing in the field of aviation. This particular field is wide open for plastics. Undoubtedly it will be proven more and more that plastics are superior to the present materials used. Like it has been proven in the past plastics are not only superior to fit the applications or to fill the requisites of the various parts but they can be made with better delivery and much greater economy. The movie also illustrated the molding techniques used by Zenith Plastics of California in the production of reinforced plastic chairs.

Following the movie Mr. Wirsch gave a formal talk on polyester resins and their applications. For those who didn't understand he described the chemical analysis of the polyester resins. He briefly covered some of the latest experiments with polyester resins, using as examples some of the more recent products produced from these resins. He touched lightly on the latest developments on work relating to the use of reinforced plastics by injection molding. In closing his talk he made himself available for questions from which an interesting open discussion resulted.

I would like to mention that Mr. Wirsch is the Technical Service Director of the Resinous Products Division of the Rohm & Haas Company. He has been with the firm for the last 12 years and is one of the leading experts on the subject of reinforced plastics. This is another program that I would like to recommend to the other sections of the Society of Plastic Engineers.

N. E. Indiana

Meers Discusses Uses of Silicones

James O. Martin

The Northeastern Indiana Section met in the Chamber of Commerce Bldg. in Ft. Wayne, Ind. on Sept. 24th.

Mr. Fred A. Meers of Dow Corning Corp. presented a movie and spoke on Silicones and their wide variety of uses and applications ranging from high temperature resistant moldings to water proofing of cloth. Many samples were shown. A very interesting and informative discussion period followed.

The Northeastern Indiana Section meets the fourth Friday of each month at 8:00 P.M. in the Chamber of Commerce Bldg. of Ft. Wayne, Indiana. All interested parties are invited to attend. At 6:15 P.M., each meeting is preceded by an informal dinner at Monochio's Grill on South Broadway which is only one block south and three blocks west of the Chamber of Commerce Bldg. The Chamber of Commerce Bldg. is just west of the downtown section of Ft. Wayne.

Southern Cal.

Weight-Feeding vs. Volumetric-Feeding Merits Are Debated

Felix C. Karas

The October meeting of the Southern California Section of the Society of Plastics Engineers featured as its topic "Uniformity of Loading" with Mr. Rubin Klinger as the speaker. The advantages of "weight-feeding" over "volumetric-feeding" of plastic injection machines were pointed out. These advantages are mainly elimination of part weight variations, saving of material, and elimination of packing and sticking in the mold, resulting in higher quality of the molded part, fewer rejects, better dimensional tolerances, less wear on pumps, presses and molds. The speaker outlined also the history of "weight-feeding." In 1946, polystyrene materials became available for wide use in injection molding. The new material differed from the then conventional acetates and acrylics. It had many advantages but it also required more precision in handling. One of the most important requirements for the use of polystyrene material was accuracy in feeding the injection press. This requirement, according to the speaker, started the development of automatic weight feeders. A very lively discussion and question and answer period lasting about 45 minutes followed the talk. The statement of several participants in the discussion that in their shops the automatic weight-feeders had paid for themselves within a very short time by savings in materials alone aroused quite some interest. The possibility of using automatic weight-feeders in preform machines for special thermosetting materials was also mentioned during the discussion.

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Central Ohio

Every Wife Wins Prize At Meeting

William Croll

The September meeting of the Central Ohio Section of The Society of Plastics Engineers was held at Ricardo's Restaurant in Columbus, Ohio on September 23, 1954. The members of the Section were accompanied by their wives for this dinner meeting.

Following this, the door prizes were awarded to the lucky winners. Due to the fine work of the Door Prize Committee, consisting of Jim Charlton, chairman, and Bill Kline, there was a door prize for each wife. Also favors included were snack trays and Westinghouse cook books.

Following this, we had a very interesting talk on "Freon," the liquid used in refrigeration, by Mr. R. S. Buchanan, Manager of the Development Section, Westinghouse Electric Corporation, Columbus, Ohio. Mr. Buchanan demonstrated the odorless, tasteless and harmless qualities of the liquid while explaining the refrigeration process with this gas converting from the liquid to the gas and then returning once again to the liquid. The talk included such examples as freezing of goldfish and then bringing them back to life, freezing grapes and distributing them for general consumption among the guests.

Golden Gate

Hold Joint Meeting

T. V. Malianni

The plastics industries of the East Bay inaugurated their fall season by holding a joint meeting of THE SOCIETY OF PLASTICS ENGINEERS and THE SOCIETY OF PLASTICS INDUSTRIES.

Both organizations met for cocktails and dinners at Fishermen's Pier in beautiful Jack London Square in Oakland.

The dinner was presided over by Dick Weber, President of the Engineers. Since both organizations were present, no business meeting was held and remarks were limited to those pertinent to the occasion and coming events for the fall season.

Following dinner, the entire group visited the plant of Catchall Crafts, fabricators of vinyl sheeting where the management had arranged for working crews to be on hand to demonstrate actual manufacture.

Cleveland-Akron

The Cleveland-Akron December meeting will be a Christmas party to be held December 10, at Aurora Inn at Aurora, Ohio.

Southern Section

Plant Tours Highlight Section's Fall Meetings

C. Veazey LeCraw

The Southern Section was fortunate to be able to tour Fulton Bag & Cotton Mill for its September meeting and Southern Plastics Company and Colonial-Hites Company for its October meeting.

Mr. Charles Neal of Fulton Bag in Atlanta showed the group their complete polyethylene film extrusion and heat sealing equipment for the manufacture of polyethylene bags for packaging.

Southern Plastics Company & Colonial-Hites Company, both of Columbia, South Carolina, invited the group over from Atlanta and treated them to a fine meal and guided tours through their plants. Southern Plastics specializes mainly in extrusion and compression molding of thermoplastics. Mr. Jules Lindau, Southern Section vice president, was the host at Southern Plastics. Mr. Henry A. Brown, Jr., of Colonial-Hites, led the group on a tour of their facilities which consists mainly of a complete sign shop including design and fabrication of all types of plastic and metal signs.

On November 8, Mr. J. W. Mighton, Plastics Technical Service Group of Dow Chemical Company, was scheduled to talk to the group on vacuum forming of high impact strength polystyrene. Mr. Mighton is planning to bring some portable forming equipment so that he may demonstrate forming techniques.

Plans for the December meeting have not been finalized as yet but will involve a supper meeting and program to which the members will bring their ladies.

The Southern Section is continuing to expand in number and influence. After only six months of existence, the rolls show 63 members. The meetings have been well planned and well attended and it is felt that a greater interest in plastics in this section of the country will be promoted through the influence of the Southern Section.

Detroit Section

Seventy Participate In Fall Golf Outing

J. H. Kuhn

Seventy members and guests of the Detroit Section enjoyed the fall golf outing at Western Golf and Country Club. The 30 golfers present had a fine time playing the tricky different course. Even Alex Kindsvater, the club pro, couldn't break into the 70's.

Later in the day, after distribution of the golf and door prizes, Carl Whitlock introduced Mr. Herb Bumpus of the Michigan Bell Telephone Company who discussed "Communication Skyways," at which time he described the micro wave radio relay facilities which Bell Telephone is using to form television networks to bring television to the viewers. Mr. Bumpus, with his visual and auditory props, gave a very interesting demonstration of this peace-time use of radar.

SOUTHERN SECTION members board a Southern Airways DC-3 at Atlanta on their trip to Columbia, S. C., where they participated in the October meeting of the section.

Newark

Plastic Course at Newark College With SPE Help

D. J. Mullins

The October meeting of the Newark Section S.P.E. was marked by the appearance of three guest speakers: Winslow A. Ward and William Sloatman of American Cyanamid Company and Dr. Robert J. Prochaska of General Electric Company.

Messrs. Ward and Sloatman discussed ureas and melamines and melamine laminates. Through the media of illustrative slides and sample products both gentlemen gave comprehensive reports on the inception of these plastic materials, how these resins are produced and their end uses.

Dr. Prochaska, who discussed "Irradiated Polyethylene," described the work that has been done at General Electric Company on their irradiated polyethylene with high energy electrons. Dr. Prochaska advised that Irathene 101 is only available from pilot plant batches and he described its physical properties the most notable of which are Irrathene 101's outstanding resistance to stress cracking, its similarity to a thermosetting plastic and its ability to perform like vulcanized rubber when subjected to heats greater than the normal melting point of polyethylene.

With the cooperation of the Special Courses Division of Newark College of Engineering the Newark Section of S.P.E. is endeavoring to set-up a three year training course in plastics technology. This will be a certificate course intended to train students for supervisory positions in the plastics industry. The course will cover all phases of the plastics industry in sufficient detail to provide a rounded out general training in plastic process technique. It is the aim of this course to afford those interested in plastics an opportunity to acquaint themselves with the materials, equipment and methods presently accepted in the field.

In order to determine the acceptance of such a course, a series of trial courses will be given in the evening school at Newark College of Engineering starting in January, 1955. A minimum of 15 students is required before the course can be started and if trial courses are successful it is intended that the full course be initiated in September, 1955. The details of the course have not been completed but the education committee of the Newark S.P.E. is endeavoring to establish the course summaries before the 15th of November so that enrollment can start shortly thereafter. Further information on this course may be obtained from M. A. Sanders, 734 Vine Street, Elizabeth, New Jersey or Robert Bartlett, c/o Natvar Corporation, 211 Randolph Avenue, Woodbridge, New Jersey.

Western New England

Members Urged to Make Conference

George Snyder

At their October 6, 1954, meeting, members of the Western New England Section began shaping up plans for attending the national S.P.E. conference in Atlantic City, January 19-21, 1955. Section prexy George W. Martin urged all members to make their preparations early so that sufficient hotel space can be obtained in advance and other travel accommodations organized. There is a strong possibility that a special train section will be reserved for the Western New England cortege. During the business session that preceded a talk on prehardened mold steels by Birger L. Johnson, Jr., Richard Plichta of the Faller Brush Company, Hartford, Conn., was appointed chairman of the transportation committee to handle the advance arrangements for the Atlantic City junket.

Southeastern Ohio

Art of Plain Talk Gives Members Ideas

William J. Stranathan

The Southeastern Ohio Section of the Society of Plastics Engineers had twenty-three members and guests attending the October meeting to hear the speaker of the evening give a very interesting talk on the "Art of Plain Talk."

The Rev. Donald Doss was introduced by the program chairman, George Edwards of Ohio Plastic Company, Frazeysburg, Ohio.

Rev. Doss gave a very informative talk on his subject. He summed up the "Art of Plain Talk" as being able to put your idea across to other people, whoever they may be and in any occupation. He said too many people, such as special engineers of different kinds, can only explain or speak in the language pertaining to his occupation, and should adjust his speech so the others can understand.

Rev. Doss also explained why and how foreign languages are really more simple than our own English language.

A buffet supper was enjoyed preceding the speaker and President John Chomicz was in charge of the meeting.

Membership was again the topic of discussion and the secretary announced that we gained two members by transfer from the Central Ohio Section. They are Bill Yost and Frank Chute. We wish to extend to them our heartiest welcome.

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Thanksgiving Day has just passed and I hope you remembered to give thanks in the Church of your choice. Each of us should be thankful that we know how to climb but more important, we should be thankful that we have the opportunity of helping others to climb. After all, being a helper to others fulfills the ideal of the greatest person who ever lived.

Yours for Better Living with Plastics

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WAYNE I. PRIBBLE

Conference Program . . .

(Continued from page 18)

G-E Mycalex

H. M. Patterson from General Electric Co. will present technical data obtained in the development of new G-E mycalex grades. Significant new applications and technical aspects of the design problems involved will be emphasized.

New Silicone Rubbers

G. S. Irby from General Electric Co. will describe the recent developments in silicone rubber, especially G-E's new "Super Tough" grade with its greater tear strength and better oil resistance. The use of silicone fabricated parts to solve difficult engineering problems will be presented by means of case histories.

Fluorolubes, Lower Molecular Weight Polymers of Chlorotrifluoroethylene

L. S. Bovier, Hooker Electrochemical Co., will give the typical properties, liquid densities, liquid pressure, and characteristics of "Fluorolube" oils and greases. The effects of "Fluorolubes" on the properties of various plastics at room temperature and elevated temperatures will be shown. Information on the application of "Fluorolube" will be included.

Temperature Control With Mold Design

C. H. Whitlock, C. H. Whitlock Associates, will discuss the problem of designing the mold to obtain the ultimate in temperature control for the most satisfactory results in any plastic forming operation. With slides, Mr. Whitlock will show case histories of improper channeling in injection molds and the corrective measures taken. How a hot mold under temperature control can actually give greater production with better quality control than a cold mold will be explained.

Luncheon Speaker John LaCerda

John LaCerda is one of the country's foremost public relations experts.

He is owner of The John LaCerda public Relations Agency, 1500 Walnut Street, Philadelphia, and president of the Public Relations Management Corporation, a world-wide public relations network which he helped to organize.

A former newspaper editor and foreign correspondent, he reported for The Philadelphia Bulletin from 42 countries. His articles were syndicated world-wide by the North American Newspaper Alliance and he also broadcast from overseas for various networks.

He is the author of articles for many major magazines and also wrote the first post-World War II book on Japan. Another of his books, published in Japanese was a best seller in the Orient.

He is president of the famous Poor Richard Club in Philadelphia; a national director of the American Public Relations Association and former president of the Philadelphia chapter; vice-president of the Philadelphia Professional Writers' Club; member of the Public Relations Society of America, Union League, Cynwyd Club, Overseas Press Club, Tokyo Correspondents Club, Berlin Press Club, Pen & Pencil Club, Philadelphia Press Association, Philadelphia Public Relations Association, and Philadelphia Advertising Golf Association. He is in Who's Who in the East.

He has received a number of national awards for public relations programs carried out for his clients.

Norman A. Skow

Wayne Pribble

Molding of Teflon

C. M. Hobson, Jr. U. S. Gasket Co., will begin with the basic principle of converting TFE powder into homogeneous solid form. He will then describe the general types of converted material available such as sinter powder and paste extruded parts, cylinders, and molded parts. The major problems encountered in the conversion of TFE such as contamination, mold material, moisture, etc., will also be discussed. Mr. Hobson will bring the talk to a conclusion by showing how the fabrication of TFE is analogous to sintered metallurgy and how the properties of TFE can be altered by techniques and fillers.

Molding and Fabrication of Polymonochlorotrifluoroethylene

William C. Campbell, U. S. Gasket Co., will begin by describing the various types of molding. Considerations in injection molding, extruding, compression molding, and transfer molding such as equipment, design factors, molding practices, and cost considerations will then be discussed. Fabricating techniques of machining, grinding, drilling and tapping, and cementing and welding will bring the talk to a close.

Runnerless Molding

Ernest P. Moslo, Moslo Machinery Co., will elaborate on the tried and proven methods of runnerless molding such as direct injection from a nozzle into a single mold cavity, direct injection from multiple nozzles into two or more cavities, and hot or confined runners to multiple cavities. Design detail of the various methods in use today will be shown. Several methods that are being experimentally used at this time will be described.

Progress in Polyethylene Materials

J. E. Brister, Bakelite Co., will stress the properties of polyethylene that relate to its successful use in wire, pipe, film, bottles and miscellaneous moldings. Some mention will be made of modifications to polyethylene for specific uses. Economics of the materials will be touched on briefly.

Laminates for Printed Circuits

Mr. Norman Skow, Synthane Corporation, will give a brief history of printed circuits and then mention some of the problems encountered in developing a plastic laminate for printed circuitry. Methods of manufacture of foil clad laminates will be described. The stamped circuit, silk screening, photo-etching, and other methods of fabricating printed circuitry will be discussed.

Engineering of Mold Design

Wayne I. Pribble, Pribble Plastics Products, Inc., will cover the considerations that must be given the tool makers' and molders' problems from the viewpoint of the mold designer. A typical medium size phenolic molding (table model radio cabinet) will be carried through the following stages: how a good part drawing helps the mold designer, basic data required from molder, initial mold layout, development of assembly drawings, and importance of detail drawings. This "How to do It" paper will be well illustrated by slides and other visual aids.

Heat Bonding of "Teflon" Tetrafluorothylene Resin

F. J. Wayne and W. M. Bruner, DuPont, will explain how the difficulties in bonding Teflon to itself are largely removed by a new method. This is accomplished by heat bonding sections of Teflon at a temperature of about 375°C. with the aid of a flux-like material under a contact pressure of about 35 lbs. in.^{2}. Heat bonding of Teflon for use in various industrial fabricating operations such as the lining of vessels and fume ducts will be described.

Welding and Flame Sproying of Plastics

J. A. Neumann, American Agile Corporation, will give information on the history and description of welding and spraying guns, the methods of welding and spraying, and the plastics that are suitable for welding and spraying. Applications of welding and spraying in vessels, duct lines and covered appliances will be discussed. The future of plastic materials as structures for industry will be outlined. This paper will be illustrated by thirty colored slides.

Modern Applications for Molded Styrene Sheet

Robert F. Hrudka, Chicago Molded Products Corp., will describe the new combinations of materials and fabricating techniques that are greatly extending the use of modified styrene sheet. New materials include those of a brilliant finish and those with improved impact strength. Improved techniques include a combination of stretch forming and vacuum forming, controlled area or pattern heating, and new types of inserts to provide reinforcement and or complex shapes. Several detailed case histories will also be given.

Plastics for Aircraft Tooling

Mr. Sokol, Republic Aviation Corp., will discuss the types, comparative tests, typical applications and probable future scope of plastics in aircraft tooling with emphasis on glass reinforced laminates and cast epoxy resins. A study will be presented of the effect of time and temperature on the creep resistance of room temperature cured epoxy-glass laminates. Specific formulations of filled resins for various tooling applications will be discussed as well as the tailoring of resin fillers and catalysts to suit the requirements of a particular job.

Asbestos-Reinforced Plastic Manufacturing and Design

Mr. Wm. E. Braham, Zenith Plastic Co., will give the results of pioneer work done by his company in the development and design of asbestos-reinforced plastics for high-speed aircraft and guided missiles. Because asbestos has greater strength and stiffness than glass fibers, Mr. Braham believes that the development of the asbestos laminating process can greatly assist the Air Force and Aircraft industry in meeting the demands of extreme temperature and stress.

Molding Granulated Wood

Kenneth H. Brockschmidt, Plastics Engineering Co., will show how sawdust, wood flour, fine shavings, etc., with powdered phenolic resin binder can be molded to a finished shape in one operation. Utilizing wood-waste in this manner, a higher resin content can be used and still be competitive with the least expensive wood products on the market.

New York

Retailer Tells Plastics Men Factors In Saleability

Arthur M. Merrill

The problems encountered by buyers of plastic products were the general topic under discussion at the October 20 meeting of the New York Section SPE, held at the Gotham Hotel, New York, N. Y. Members of the panel included Goldie Kopelman, housewares buyer for Bloomingdale's department store, H. Katz, purchasing agent, Emerson Radio & Phonograph Corp., Monte Levin, industrial designer, and Stanley Bindman of The Jamison Plastic Corp. acted as panel moderator.

Miss Kopelman presented the direct retailer-to-consumer point of view, and stressed the importance of trademarked plastics products. The great variety of chemical names of plastics, she said, mean very little to the average female purchaser and tend to create buyers' resistance. She urged that even plastics in low-cost items be dignified my easily-remembered names. Improved colorations were also needed in the industry, she asserted, as well as general product improvement.

Mr. Katz discussed some of the pitfalls encountered in his long-time relations with molders and how he set about choosing the right molder for a particular job. Very often, he said, he refused the offer of a molder who was willing to do the job at a temptingly low margin of profit. The cooperation so needed in smooth business relations, in such things as retrieving sub-standard items or accepting suggestions for minor changes in material or design, was not always forthcoming from these manufacturers, he asserted.

Mr. Levin traced the pattern of his responsibilities as industrial designer from his initial contact with industrial buyers to the final production of the item. An important facet of his task, he said, often was to design an item that can be produced in both low-cost and expensive models from the same mold facilities. The use of this technique, he pointed out, severely cuts the manufacturing cost of the higher-priced model and disproportionately boosts its margin of profit.

The 125 members and guests present at the meeting engaged in a vigorous question-and-answer period following the addresses. Predominantly molders, engineers, and salesmen, they countered many of the off-hand criticisms leveled at them by the speakers, and delineated the problems forced upon them by the contradictory demands of manufacturers, retailers, and consumers.

Harold Schwartz, chairman of the New York Section, Palmer Humphrey, secretary, and Bill Lewi, vice president, presided over the business portion of the evening's activities. Joe Healy congratulated the organization on its ever-increasing membership and on its salutary role in the American plastics industry. Progress of the group's educational program to ensure an adequate supply of technicians for the industry was discussed by other members.

Reinforced Plastics Group

The Reinforced Plastics Group of New York Section, held a regular dinner meeting on October 27, 1954 at McGinnis' Restaurant, Jamaica, New York. Two talks highlighted the technical session as follows: "Efficient Operation for Short Production Runs," by Louis Linzmeyer and William Haynes of Duraglass Laminates, Inc.; and "Chemistry of Epoxy Resins," by Elliott Dorman, Ciba Company.

A total of 20 new members was added by the New York Section during the month of October. The new members are as follows: John D. Avignone, manager of plastics mold div., M. A. Cuming & Co.; William J. Canavan, development engineer, Bakelite Co.; Harold V. Ettore, supervisor of research and product development, plastics div., Empire Brushes, Inc.; Hal Curtis Felsher, director of research & development, Claremont Pigment Dispersion Corp.; Edward E. Finney, technical representative, Naugatuck Chemical Div., U.S. Rubber Co.; Henry Fishbeck, vice president, Arliss Co., Inc.; Robert D. Handley, sales manager, Formvac Corp.; George H. Howell, sales engineer, Formvac Corp.; Seymour Lewis, technical director & product manager, American Molding Powder & Chemical Co.; Frank J. Nussbaum, president, Riverside Plastic Corp.; Joseph C. Oppenheim, Jr., chemist, Bassons Industries Corp.; Donald J. Perrella, sales representative, National Aniline Div., Allied Chemical & Dye Corp.; Hans J. Poll, product manager & purchasing agent, Duraglass Laminates, Inc.; Michael S. Rhodes, technical sales, National Aniline Div., Allied Chemical & Dye Corp.; Guy G. Rothenstein, designer & consultant; Joe Salata, secretary, Diemasters, Inc.; Harry C. Tomford, vice president, Riverside Plastic Corp.; George W. salesman, A. Bamberger Corp.; C. Wittenwyler, senior technologist, Chemical Corp.

West New-England

Petretti Talks On Reinforced Plastics

George Snyder

John LaBelle, national president, was guest of honor at the West New England Section's November meeting, an event highlighted by a fabulous giveaway program, SPE officials, industry notables, and two expert speakers.

Over 125 members and guests were on hand to hear past national president Mario Petretti (Camfield Fiber Glass Plastics, Inc.) deliver a scholarly thesis on the engineering aspects of fiber glass reinforced molding. Fiber glass cloths, fiber glass mat reinforced polyester, fiber glass preforms and pre-mixed compounds were among the topics that were slide-illustrated and discussed in Mr. Petretti's thorough analysis of this phase of the industry.

Second speaker of the evening was Robert Butzko (Auto-Vac Company) who gave an enlightening talk on the tremendous strides made in the vacuum forming field in the past two years, in product development, engineering, raw materials and processing equipment. He painted a rosy picture about the growth prospects of vacuum forming which he spelled out in terms of a 200-million-pound market by 1960. Only 10% of all vacuum forming is now being done by plastics companies, he said, but the attractive economies and almost unbelievable range of product possibilities are making vacuum forming a major segment of the industry.

Setting the appropriate theme for Low Pressure Night, a 15-foot sportsman's runabout with fiber glass hull and mahogany deck and trim was given away as the main attendance prize. It was won by Dave Lagerbo, a guest at the meeting. The list of prizes also included a pastel green molded polyester wash tub, an electric automatic toaster and a 3-foot high vacuum-formed Santa Claus display.

Mr. Sherwood Young (C. F. Clesco.) acted as technical chairman during the meeting. Among the many guests in attendance were C. Wilbur Cleworth, publisher, and George S. Rhine, editor, of "Plastics World" magazine.

Rhode Island and S. E. Mass.

Radioactive Tracers in Molds Show Erosion of Various Plastics

Stephan Kalarian

A small group of 33 members paved the way for the October meeting of the R. I. and Southeastern Mass. Section of the SPE by enjoying cocktails and miscellaneous drinks at the Wayland Manor in Providence. After a long cocktail hour, a good meal, and a short business session, President Roy Slipp introduced guest speaker Al Landall of General Electric.

Mr. Landall has been with G. E. for 23 years. He has experimented with laminates, worked on thermoplastic and thermosetting materials, and is now affiliated with the Chemicals Dept. in Pittsfield, Mass.

Mr. Landall's topic was "Use of Radioactive Tracers in Mold Erosion." He commenced his talk by saying mold erosion has always plagued the plastics industry. In the early days various materials were used for molds. Eventually steel became the accepted medium and in particular S.A.E. 3312 is common for the actual dies. To prolong the life of a cavity, the dies were hardened and then chrome plating was found to be helpful; however, with various molding materials, the erosion problem still was present. Since metallurgists have not come up with better wear-resisting alloys, the molder looked for less erosive molding materials and possible variation of molding techniques to give longevity to his molds.

In order to determine which molding material yielded the least wear in molds, it was necessary to measure the amount of wear in the dies. It was possible for example to pass molding material over an injection molding torpedo and note the results; however, this would take several weeks before any appreciable wear was detected. The amount of wear of course being the difference in weight of the spreader before and after the experiment. A more feasible method seemed to be to employ a 100 gram sprue bushing in a transfer mold. This bushing was made of SAE 3312 steel and was radioactivated in an atomic pile at an average thermal flux of 4×10^{12} neutrons per sec. cm.^{2}. The components of 3312 are iron, nickel, chromium, manganese and carbon. Of these elements only radio-active iron and chromium had sufficiently long half life and emitted satisfactory gamma radiation for the desired work. As the molding material was transferred through the sprue, it would wear off some of the radio-active steel from the bushing and naturally become a part of the molded piece. The amount of metal worn off would depend upon the erosive characteristics of the molding material. This radio-active molded part was placed in a shielded metal housing and the gamma rays were counted by a scintillation counter. This yielded 37 millicuries of radiation. The count yielded by one particular molding material was compared against the counts yielded by other molding materials. It was the ratio of counts that determined which materials were more abrasive.

The results of various tests showed that materials with abrasive fillers caused the most wear, especially talc. Tests also showed that erosion is probably affiliated with crystal structure and not with hardness alone. Strangely enough added lubricants to a compound did not decrease the wear rate. Wear rate was decreased by employing lowest feasible molding pressures and using preheated materials.

Mr. Landall's talk was enhanced by a movie covering the same subject. His excellent presentation and his mastery of the subject prompted many questions.

The door prize, which was a cigarette lighter embedded in plastic, was donated by Plastic Developments of Attleboro, Mass. and was won by this writer.

Detroit

Mold Finish On Vinyls Improved

T. V. Malianni

On October 25, 1954 43 members and of the Detroit Section of the SPE attended a dinner meeting at the Engineering Society of Detroit Club Rooms in the Rackham Memorial Building, Detroit, Michigan.

Our President, Carl Whitlock, gave a report on the recent Society of Plastics Industry New England Section meeting at Bretton Woods, New Hampshire. Enthusiasm over the future of the plastics industry evidently ran high at this meeting because Mr. Whitlock gave a glowing report of the terrific expansion by material suppliers of their facilities to meet the future plastic market. A definite challenge now lies ahead for the individual molding and fabricating companies to go out and secure business which the molding material suppliers have foreseen to be possible. This is not a new challenge, but is one of that has been met many times before by molders and fabricators who often have forged ahead on their own to create new markets.

Iver Freeman, Program Chairman, introduced Mr. Robert Hill of Monsanto Chemical Company, who discussed the future of the vinyl molding compounds as they will affect the injection molders. Mr. Hill dwelled at length on the improvement in molding techniques and the physical properties of the vinyl resins that definitely are leading to increases in the expanding market for the vinyls. The improvements in techniques of handling vinyl compounds have been aimed at reducing molding costs to enable the molder to compete to better advantage with rubber. The molder who installs his own plasticizing equipment to blend vinyl compounds is now able to reduce his overall material costs. This is particularly true if he does his own coloring by dry blending. In the past, many times molders have lost small production orders for vinyl parts because of their inability to secure colored vinyls in small quantities.

Many samples were shown that illustrated the improved surface finish characteristics of present day vinyl moldings. Molding techniques to achieve these finishes were discussed by Mr. Hill and many members of the audience added to Mr. Hill's information with case histories of their own experiences in vinyl.

Golden Gate

Sales Problems In Plastics

J. W. Kuhn

The second dinner meeting of the fall season of the Golden Gate section of the society of plastics engineers was held on Thursday, October 28, at the Old Grotto in San Francisco.

President Dick Weber presided over the short business meeting and then introduced Mr. Ernest Smyth, Sales Representative, of Rohm & Haas Company. Mr. Smyth gave a comprehensive talk on "Sales Engineering in the Plastics Industry," pointing out sales problems faced in the plastics field. He particularly stressed the problems of "prejudices" common to everything that is new and emphasized that the surest way to overcome these was for the salesman to have a thorough knowledge of his products and their manufacture.

A question and answer period followed his talk which permitted elaboration of his several highlights.

Further mee

Creep of Acrylics . . .

(Continued from page 34)

the other three stresses at 7 different temperatures. The results of the analysis showed that, the data at 500 lb in^{-2} did not alter the results or conclusions of the first analysis. The first analysis is considered more useful because it includes 9 temperature conditions compared to 7 for the second analysis, and there is interaction between temperature and materials, but not between stress and materials.

From the first analysis of variance, the coefficient of variation is calculated as 16.7 percent for the elongation and 28.0 percent for the creep rate. The coefficient of variation is the standard deviation divided by the average value and is expressed in percent; it is useful for data such as those dealt with in this report where the experimental errors tend to be proportional to the magnitude of the measured values.

Conclusions

The results of this work and the analysis of the test results lead to several conclusions. The test itself is a valid and reproducible test. While the test is still in the development stage, the over-all accuracy of the results compares favorably with that of many mechanical tests on plastics. The analysis of the data indicates that the Plexiglas 55 has a lower elongation and creep rate than UVA Plexiglas II over the range of differential temperatures investigated.

Acknowledgments

The materials for this work were submitted by the Rohm and Haas Company. Mr. John Mandel, Testing and Specifications Section, Organic and Fibrous Materials Division, National Bureau of Standards, advised on statistical methods. Mr. P. M. Goodwin, Airborne Equipment Division, Bureau of Aeronautics, Department of the Navy, was Cognizant Bureau of Aeronautics Engineer. The advice and help of the Bureau of Aeronautics, the company and these individuals, as well as of others at the National Bureau of Standards, are gratefully acknowledged.

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Industry Notes . . .

A.S.T.M. Reinforced Plastics

Recognizing a need for coordination of information and knowledge of basic properties of reinforced plastics in such applications as automobiles, boats, building panels, railroad cars and other uses where a reinforced plastic with structural properties is desirable, ASTM Committee D-20 on Plastics has organized Subcommittee XVIII under the chairmanship of Ray B. Crepps, Director of the Testing Division, Owens-Corning Fiberglas Corp.

The committee held its organizational meeting on June 18, 1954 at the 57th Annual Meeting of the American Society for Testing Materials in Chicago. A meeting of the steering committee of the subcommittee was held on September 16, 1954 at the National Bureau of Standards in Washington to outline operational plans and procedures for its technical work.

The next meeting of the subcommittee was held at the Carter Hotel, Cleveland, Ohio, November 15-17, 1954. Interested producers and consumers of reinforced plastics may write for information to Ray B. Crepps, Route 1, River Road, Granville, Ohio.

New Thiokol Formulations

Starting formulations and resultant properties of "Thiokol" liquid polymer epoxy resin casting compounds are described in a new 12-page booklet issued by Thickol Chemical Corporation. Casting compounds of this type cure at room temperature and are suitable for electrical and electronic potting, plastic tooling, and miscellaneous casting applications.

The booklet is available on request from the Thikol Chemical Corporation, 780 North Clinton Avenue, Trenton, New Jersey.

Pyrometry Booklet

Notes on Pyrometry is a two-page article dealing with pyrometers, chemical temperature indicators, and their uses. A copy may be obtained by writing to Tempil Corp., 132 W. 22nd, New York 11, N.Y. Mention the SPE Journal.

Shell Reduces Epon Prices

Shell Chemical Corporation effective immediately has reduced the price of Shell Epon resin 828 to 90c a pound in drums by the carload and to 93½c a pound in drums less-than-carload delivered, it was announced by G. W. Huldrum, Jr., General Sales Manager. Previous prices had been 10c higher.

Epon resin 828 is the leading epoxy resin for use in casting, potting, and laminating.

Pantograph Engraver

A new **brochure**, available upon request to the Green Instrument Company, Dept. SPE, 386 Putnam Avenue, Cambridge, Mass., describes in detail the Green Model D-2 Heavy-Duty Pantograph Engraver.

The new engraver is open on three sides and equipped with a single vertical adjustment for both spindle and copy table. The brochure tells all about this unique design which enables the Model D-2 to mill, profile and engrave large panels and bulky work pieces. It also contains a full description of the engraver's rugged construction and precision-machine tooling.

Hercules Products List

All the products commercially available from Synthetics Department, Hercules Powder Company are conveniently listed with characterizing data, in a new technical booklet.

The booklet includes listing of synthetic resins, plasticizers, pentaerythritol, and nonionic surface-active agents. Certain key properities of the products are included in the listings.

Plasticizers for nitrocellulose, polyvinyl chloride, vinyl chloride-acetate copolymers, and polyvinyl acetate; and nonionic surface-active agents useful as detergents, emulsifiers, and aids in textile processing and petroleum production are covered. Write Hercules Powder Co., 930 King St., Wilmington 99, Delaware.

Spray Gun Information

A new oscillating gun pressure contact spray decorating machine constitutes the first means which permits the gun to operate in a concave arc, or pendulum type swing, to effectively coat the outside of convex areas.

The machine, designed by Conforming Matrix Corporation, is for painting areas up to 3"x6". The gun oscillates continuously to paint either a concave surface, such as the inside of a horn button, or a convex surface, such as the outside of a doll's face.

A free brochure on the machine will be sent to anyone addressing their request to Conforming Matrix Corporation, Dept. SPE 379-3 Toledo Factories Building, Toledo 2, Ohio.

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Control Charts . . .

(Continued from page 23)

may be calculated as follows:

	n = 50	n = 100	n = 200
σ	$\sqrt{\frac{(.054)(.946)}{50}}$	$\sqrt{\frac{(.054)(.946)}{100}}$	$\sqrt{\frac{(.054)(.946)}{200}}$
σ	$\sqrt{.00105}$	$\sqrt{.00510}$	$\sqrt{.000255}$
σ	.032	0.022	0.016
Control limits	0.054 ± 0.094	0.054 ± 0.066	0.054 ± 0.048
LCL	0	0	0.006
UCL	0.148	0.120	0.102

The interpretation of these control charts follows the same general rules discussed in the preceding article of the series. Runs, trends, shifts in level and excessive variability are shown by the same symptoms as were indicative of such deviations from the expected variation for $\bar{X}$ and R charts.

Defects, Not Defectives

Quite often we are interested in the total number of defects in an item, or group of items. For example, a complicated molding may have several possible defects, any one of which might cause rejection of the piece. With the **p** and **pn** charts we were concerned with defective items, but more precise control of quality and trouble shooting can often be assisted by talking in terms of the number of defects present. In addition we might be interested in counting contamination specks in molded tiles or refrigerator panels, fisheyes in extruded wire coating, visual defects in plastic film and many other similar applications.

In order to separate the chance variation in this operation from the type of variation which indicates a new or "assignable cause," a control chart such as that shown in Figure 4 should be set up, with control limits adjusted as shown to fit the sample size.

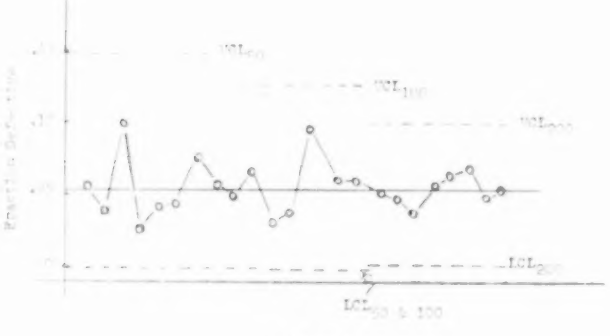

Figure 4

The basic distribution underlying the chance variation in counted data of this type is known as the Poisson Distribution. The Poisson Distribution is a simplified approximation to any term of the Binomial, and (mathematicians take note) is developed by the expansion of the transcendental number "e" as follows:

$$1 = e^{z} \times e^{-z} = e^{-z}(1 + Z + Z^2/2! + Z^3/3! + \ldots . Z^n/n!)$$

which when plotted for appropriate values of z and n, gives a distribution similar to the Binomial, and for which very complete tables have been worked out (4).

The probability limits of chance variation for this distribution are most appropriately obtained from the published tables, but as in the case of number of defectives, a workable approximation is available. In fact this approximation is developed from the formula for the standard deviation of pn, by the following line of reasoning:

If there is a large number of possible defects, and the number of defects is quite small compared to the number of defects that could have occurred, the formula for standard deviation of the pn chart can be simplified. As you remember,

$$\sigma = \sqrt{np(1-p)}$$

where n = the sample size, p = the probability of an item being defective, and 1-p is the probability of an item being non-defective. If we substitute for np the value c as representing the number of defects likely to be found in a sample of a given size, and select the size of the sample so that the value of p is quite small, 1-p becomes almost equal to 1, and the expression becomes

$$\sigma = \sqrt{c} \quad \text{for all practical purposes.}$$

The control limits for the so called "c" charts, which we apply to these processes, are given by

$$c \pm \sqrt{c}, \text{ where } \bar{c}, \text{ the average number of defects per unit is our best estimate of } c.$$

These charts are used and interpreted much in the same way as np and p charts.

A very interesting discussion of the Poisson distribution and its relation to the Binomial is given by Moroney (1), and is recommended to the reader who wishes to go more deeply into the "whys and wherefores" of "**c**" charts.

Modifications of Attribute Control Charts

There are several approaches to solution of the problem of varying sample size in attributes inspection. The simplest, of course, is to maintain a constant sample size wherever possible, so that the control limits do not have to fluctuate from time to time, and computation is kept to a minimum. If this cannot be done, and sample size must be varied even on successive samples, the use of a control chart by the operator on the job becomes complicated.

One solution often suggested is to base the control limits on an average sample size, and recompute for points which appear dangerously close to the limits (between 2 and 3 sigma for example). This chart also is difficult to administrate, and calls for a good deal of supervision.

Perhaps the most desirable solution offered to date is the stabilized "p" chart, an example of which is shown in Figure 5. On this chart, each point is plotted in relation to its probability of occurrence due to chance, and provides an excellent means for detecting trends and shifts in level on fraction defective or percent defective charts. A complete discussion is given by Duncan (2).

A Good Start in SQC

For those who are interested in improving their product quality, but who hesitate because of the [illegible]

(Please turn to page 54)

(Continued from page 42)

It was found that acrylic resins (in this case Perspex) are admirably suited for this application. Heated to the "second order transition temperature" (about 100 C), the acrylic becomes rubberlike and easily deformable. At the same time it retains a high deformation recovery. In the actual process as described here, the heating medium was boiling water, the softened wing piece was clamped against a contour board and allowed to cool.

PASQUETTI EXTRUDER.
pp 360-362

This Italian twin screw extruder comes in two sizes, CP 2V0 (screw diam. 1.7 8", drive 1.6 HP, speed 9-29 rpm, extrusion rate 8-40 lbs h) and CP 2V10 (screw diam. 3", drive 6 HP, speed 5-15 rpm, extrusion rate 44-130 lbs h).

The screws are contra-rotating and have multi-start flights (CP 2V0: 4 and 2 start, CP 2V10: 4,3, and 2 start). They are suited for PVC (both rigid and plasticized), polystyrene, cellulose acetate and acrylics. For nylon a longer screw is required with a reduced depth of thread. The heaters are 3000 and 4000 W, double wound for rapid warm up. Barrel removal for cleaning is very easy.

A special attachment for rigid tube production is available, consisting of a sizing die and air mandrel, a cooling bath and a very accurately controlled haul-off.

THE FUTURE OF POLYTHENE.
J. C. Swallow, pp 361-365

Polyethylene, a discovery of I.C.I., is now being produced in England, France, Italy, Germany, Canada and by no less than seven licenses under I.C.I. patents in the U.S.A. At the present time, the world's production is appr. 150,000 tons yr, however, by 1957 it will be of the order of 350,000 tons.

Polyethylene structure is much less simple than at first assumed. Many factors, as branching, end groups, molecular weight distribution, are of great influence on the ultimate properties. An example of this is given.

All these factors are in their turn dependent on the manufacturing conditions and these may vary among the different producers who have been developing their processes along independent lines.

A 100 fold increase in production efficiency has been achieved in the last 15 years, thus making the cost of the raw material an important factor.

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Control Charts . . .

(Continued from page 52)

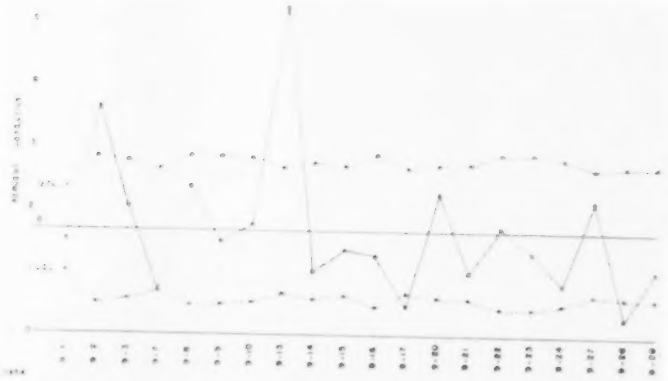

Figure 5. A "P" Chart.

and basic change in philosophy inherent in SQC, it is recommended that a simple fraction defective chart be kept by each operator as the initial approach. A good basis for a quality control program is the belief that every person wants to do a good job and is interested in knowing how well he is doing. Supervision has a strong responsibility in setting the stage, encouraging each individual to do his best, and in giving each person full credit for his effort. These simple charts have been found to be very effective in this stage setting, and improvements are often noted even before we have obtained sufficient information for calculating control limits.

Some of the advantages of p and c chart[s] over [con]trol charts for variables are

1. Many quality characteristics cannot be [mea]sured or the measurement technique is des[truc]tive, otherwise costly.
2. Some operations require control of [very] large numbers of dimensions.
3. The concept of breaking down quality into "good" and "bad" is basic, and more easily understood by all personnel.
4. Attributes charts can be used to analyze process[es] and select situations where the more sensitive $\bar{X}$ and R charts may be eventually applied [for] more sensitive control.

The use of attribute control charts, when properly handled, has often been the foundation stone for a [full] scale quality control program, which has paid off in terms of better quality, greater customer satisfaction, and [re]duced cost of operation. For the manufacturer who is [new] on SQC and wants to know where to start, the [meth]ods discussed here are recommended.

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4. Molina, E. C., "Poisson's Exponential Binomial Limit," D. Van Nostrand Co., Inc., New York, N. Y.

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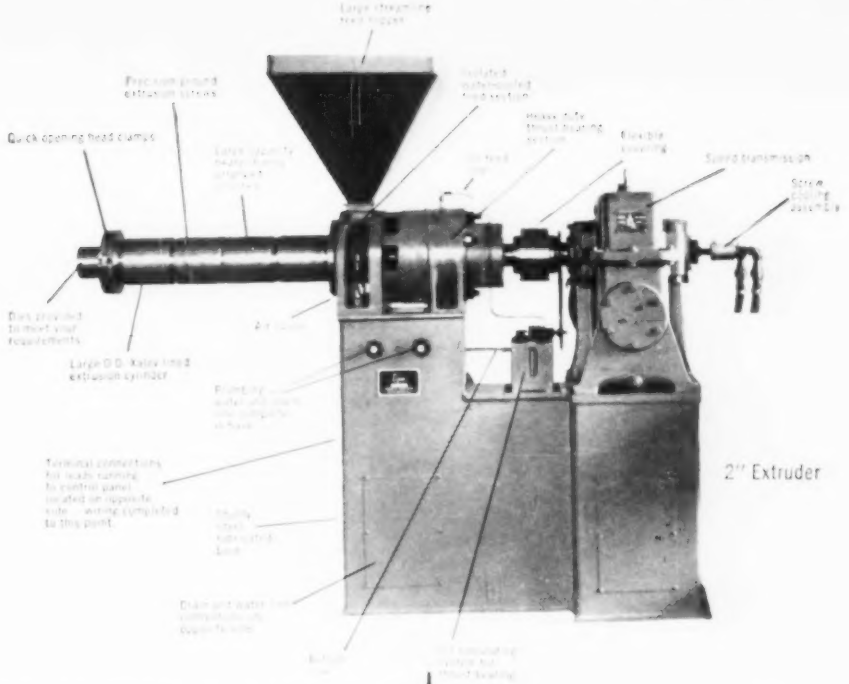
Egan plastic extruder



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Yes, when you remove the covers and get down to the bare facts of construction of this unique extruder, you will find a machine which will have longer effective screw lengths, greater maximum heating capacity, and larger thrust bearing capacity. This will add up to higher production rates, better products, and lower maintenance and operating costs. With the flexible design of the "extrusion" unit consisting of the separate components; screw, heating cylinder, feed section; and thrust bearing housing, we can give you any combination to meet your requirements.

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EGAN EXTRUDERS can be furnished with dies, conveyors, take-off equipment and other auxiliary features for a wide range of extruded products.

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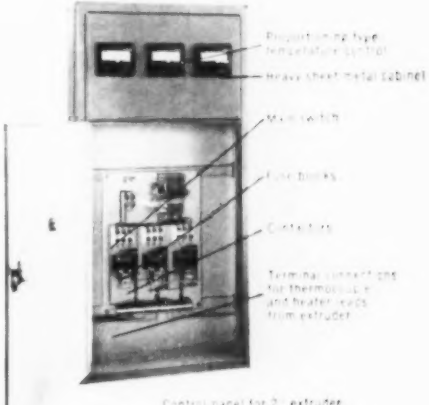

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Zones of Heating on Cylinder	2	2	3	4	4	4
Maximum Heating Load, KW	12	18	30	48	96	160
Thrust Bearing Capacity, 1000 lbs. @ 50 rpm.	60.5	60.5	119.5	208	288	420
Type Speed Transmission	Worm gear.	Worm gear.	Herr' bone	Herr' bone	Herr' bone	Herr' bone
Usual Motor Size, H. P.	7½-10	10-15	20-30	40-50	50-75	75-150
Approx. Extrusion Capacity lb./hr.	20-50	40-90	75-200	150-450	250-650	450-1200
Approx. Floor Dimensions—inches	40x98	48x112	60x120	84x132	96x156	104x192
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